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Chitiveli et al.

(10) **Patent No.: US 9,372,919 B2**
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(54) **GENERATING VISUALIZATIONS OF A DISPLAY GROUP OF TAGS REPRESENTING CONTENT INSTANCES IN OBJECTS SATISFYING A SEARCH CRITERIA**

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(73) Assignee: **International Business Machines Corporation**, Armonk, NY (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

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(65) **Prior Publication Data**

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Related U.S. Application Data

(63) Continuation of application No. 13/463,318, filed on May 3, 2012, now Pat. No. 8,954,428, which is a continuation of application No. 13/397,596, filed on Feb. 15, 2012, now abandoned.

(51) **Int. Cl.**

G06F 17/00	(2006.01)
G06F 17/30	(2006.01)
G06F 17/24	(2006.01)

(52) **U.S. Cl.**

CPC ***G06F 17/30696*** (2013.01); ***G06F 17/30991*** (2013.01); *G06F 17/241* (2013.01)

(58) **Field of Classification Search**

None

See application file for complete search history.

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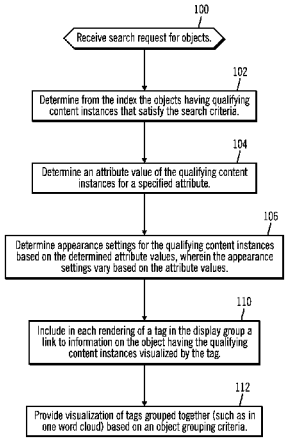
(57) **ABSTRACT**

Provided are a computer program product, method, and system for rendering search results. A search request is received having a search criteria to perform with respect to objects having content instances. A determination is made of the objects having qualifying content instances that satisfy the search criteria, an attribute value of the qualifying content instances for a specified attribute, and appearance settings for the qualifying content instances based on the determined attribute values. The appearance settings vary based on the attribute values. Tags are generated indicating the content instances and appearance settings for the content instances. A visualization of the tags in a display group are generated to provide visualization of the qualifying content instances in the objects according to the appearance settings, wherein visualizations of the tags is varied based on the determined appearance settings.

20 Claims, 30 Drawing Sheets



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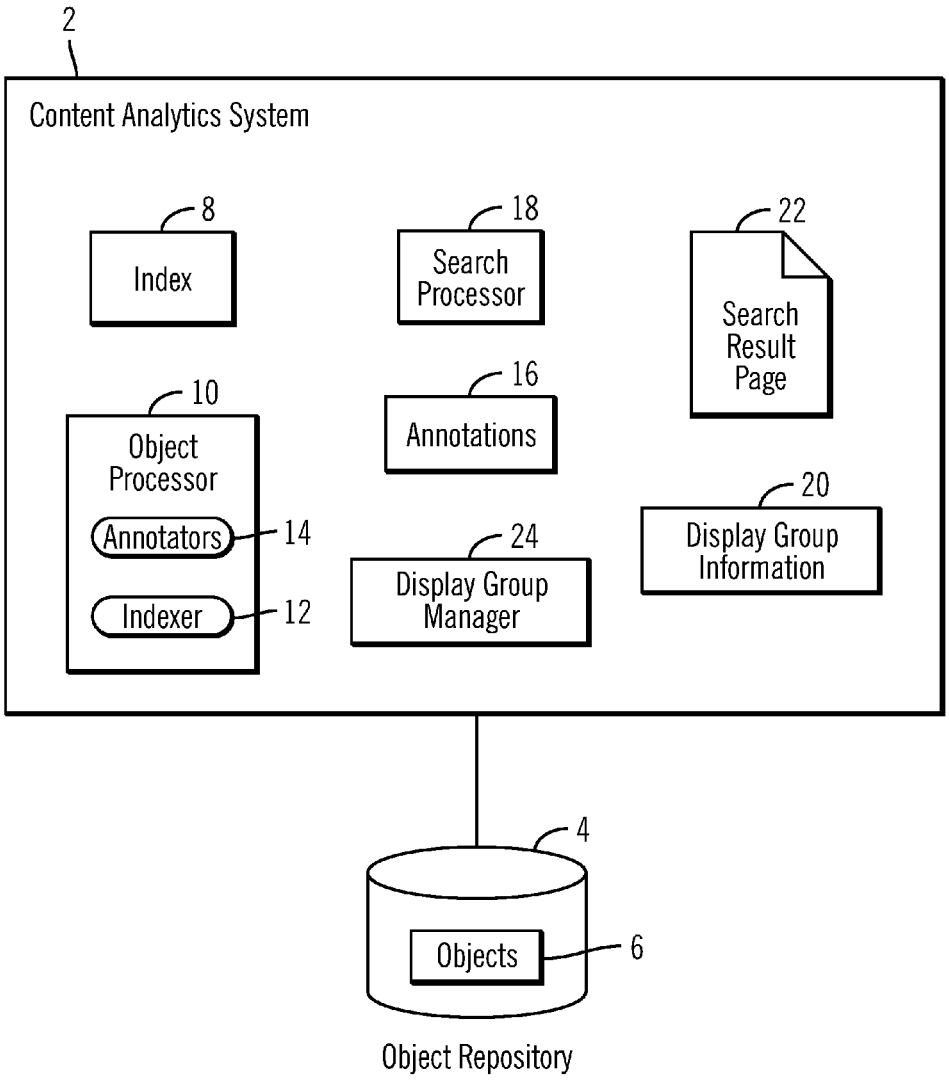

2
Content Analytics System
8
Index
18
Search Processor
22
Search Result Page
10
Object Processor
Annotators
14
Indexer
12
16
Annotations
24
Display Group Manager
20
Display Group Information
4
Objects
6
Object Repository

FIG. 1

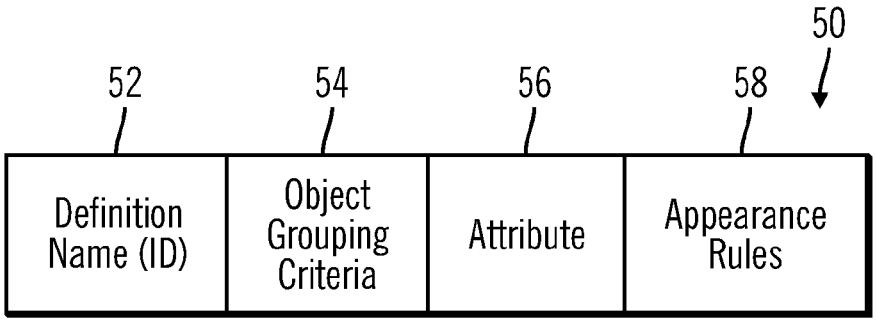


FIG. 2

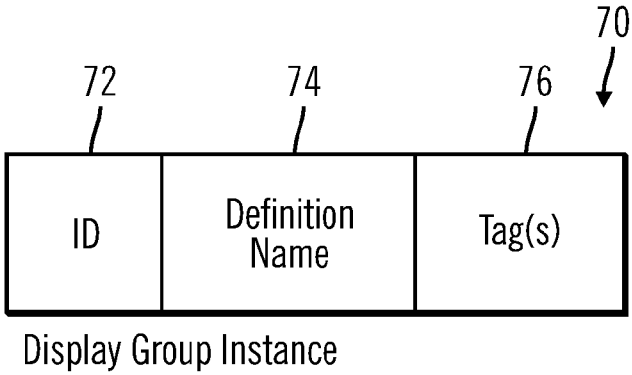


FIG. 3

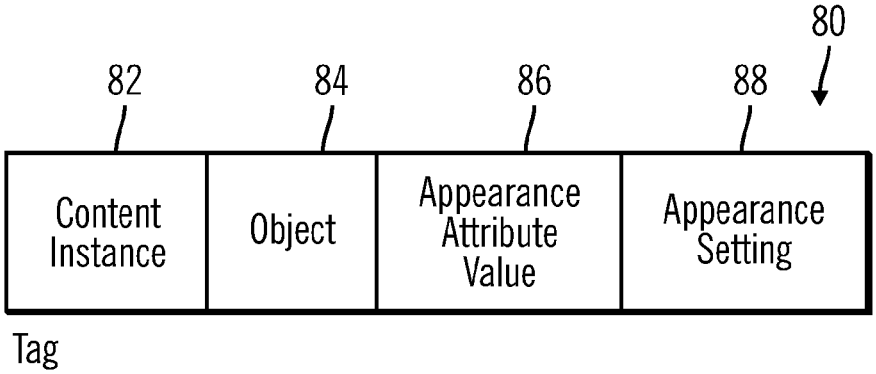


FIG. 4

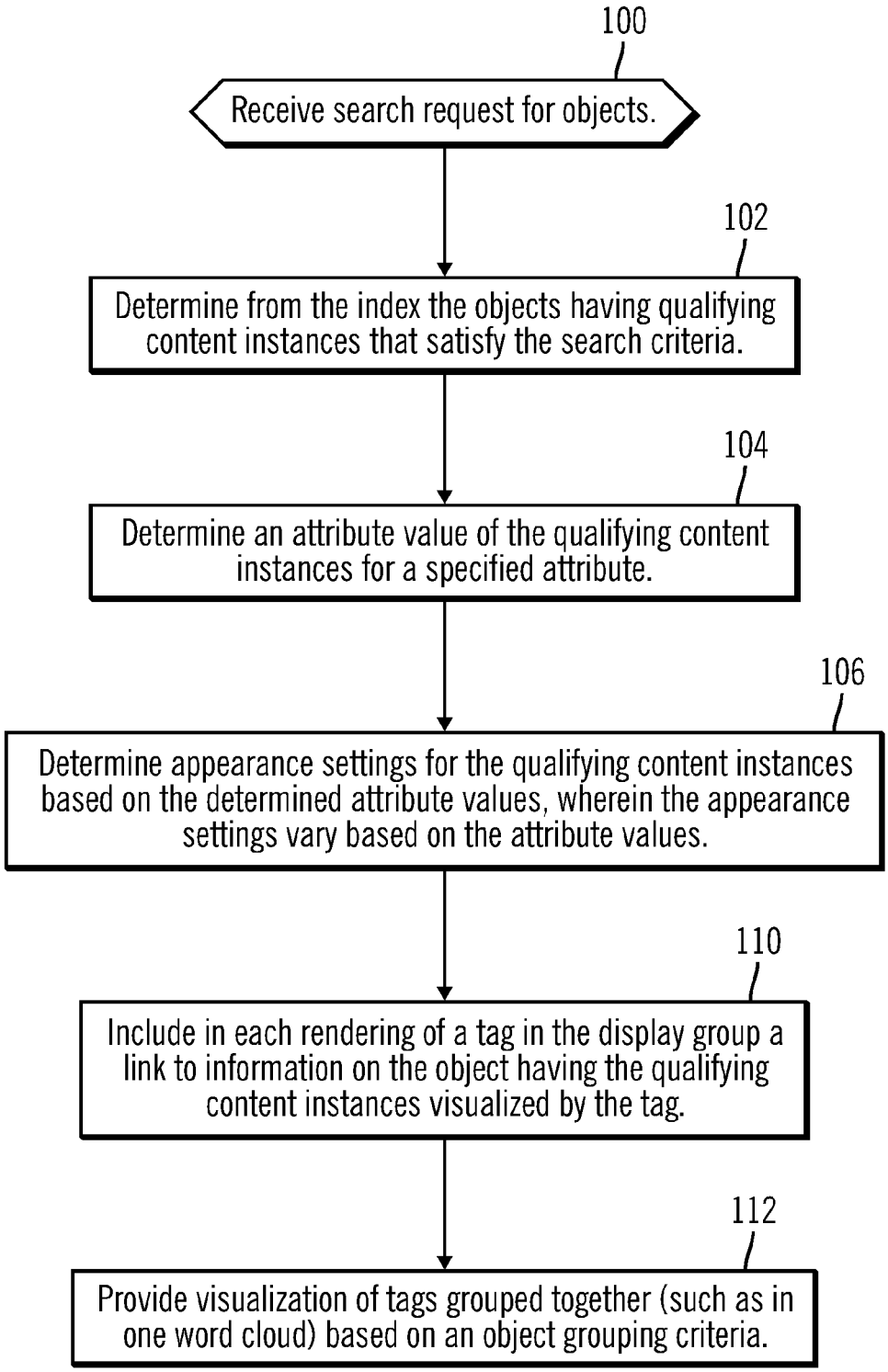

100
Receive search request for objects.
102
Determine from the index the objects having qualifying content instances that satisfy the search criteria.
104
Determine an attribute value of the qualifying content instances for a specified attribute.
106
Determine appearance settings for the qualifying content instances based on the determined attribute values, wherein the appearance settings vary based on the attribute values.
110
Include in each rendering of a tag in the display group a link to information on the object having the qualifying content instances visualized by the tag.
112
Provide visualization of tags grouped together (such as in one word cloud) based on an object grouping criteria.

FIG. 5

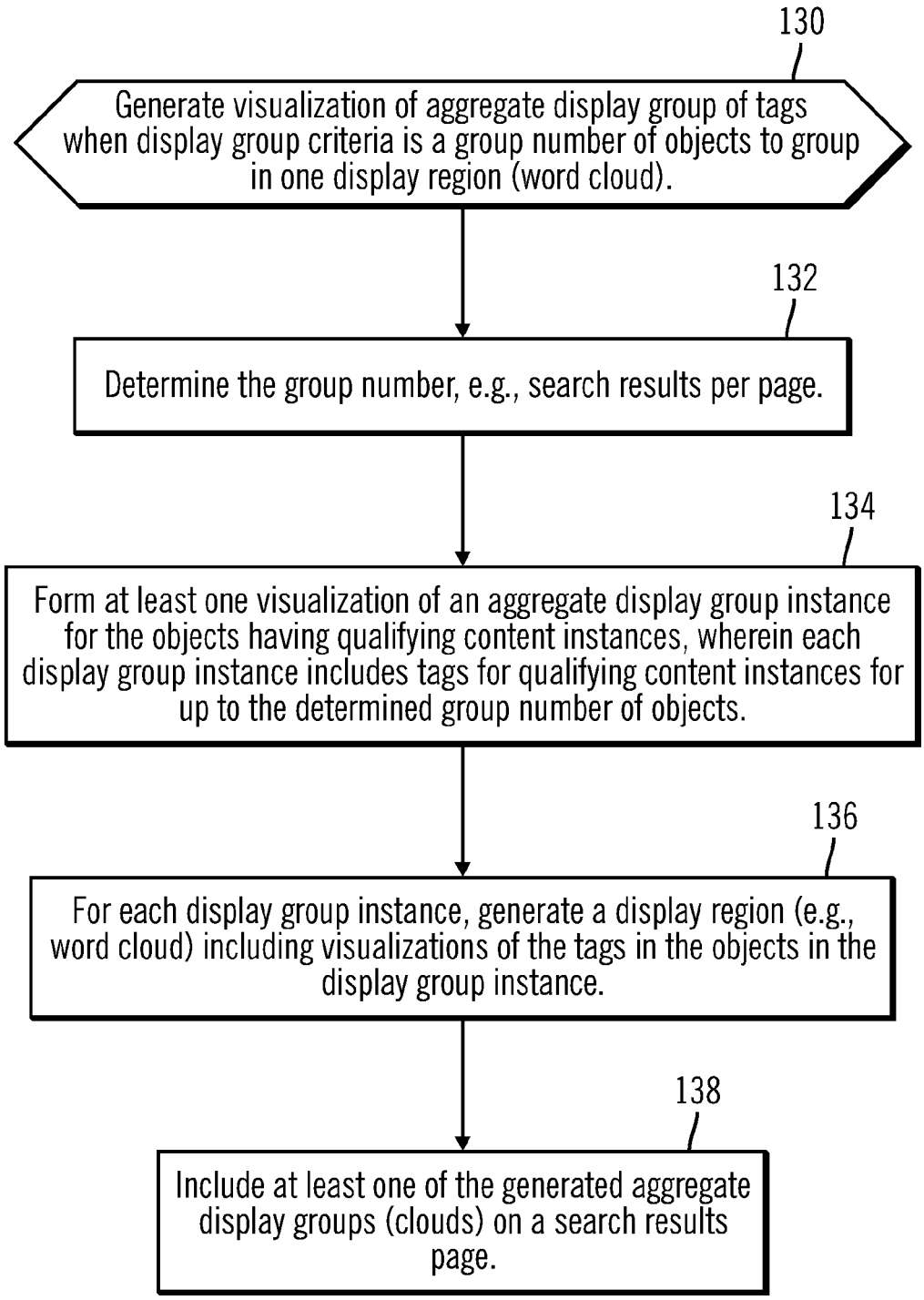

130
Generate visualization of aggregate display group of tags when display group criteria is a group number of objects to group in one display region (word cloud).
132
Determine the group number, e.g., search results per page.
134
Form at least one visualization of an aggregate display group instance for the objects having qualifying content instances, wherein each display group instance includes tags for qualifying content instances for up to the determined group number of objects.
136
For each display group instance, generate a display region (e.g., word cloud) including visualizations of the tags in the objects in the display group instance.
138
Include at least one of the generated aggregate display groups (clouds) on a search results page.

FIG. 6

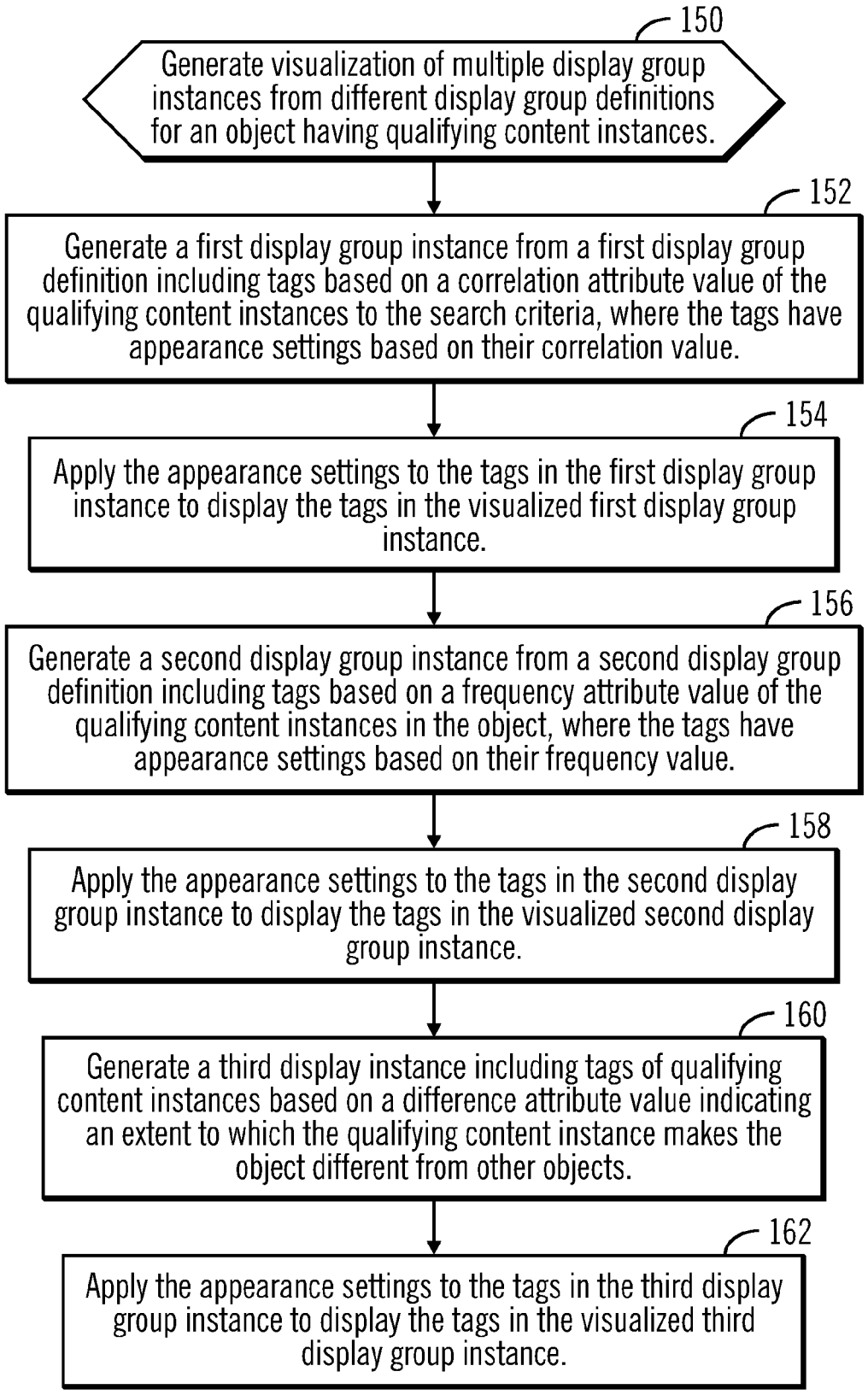

150
Generate visualization of multiple display group instances from different display group definitions for an object having qualifying content instances.
152
Generate a first display group instance from a first display group definition including tags based on a correlation attribute value of the qualifying content instances to the search criteria, where the tags have appearance settings based on their correlation value.
154
Apply the appearance settings to the tags in the first display group instance to display the tags in the visualized first display group instance.
156
Generate a second display group instance from a second display group definition including tags based on a frequency attribute value of the qualifying content instances in the object, where the tags have appearance settings based on their frequency value.
158
Apply the appearance settings to the tags in the second display group instance to display the tags in the visualized second display group instance.
160
Generate a third display instance including tags of qualifying content instances based on a difference attribute value indicating an extent to which the qualifying content instance makes the object different from other objects.
162
Apply the appearance settings to the tags in the third display group instance to display the tags in the visualized third display group instance.

FIG. 7

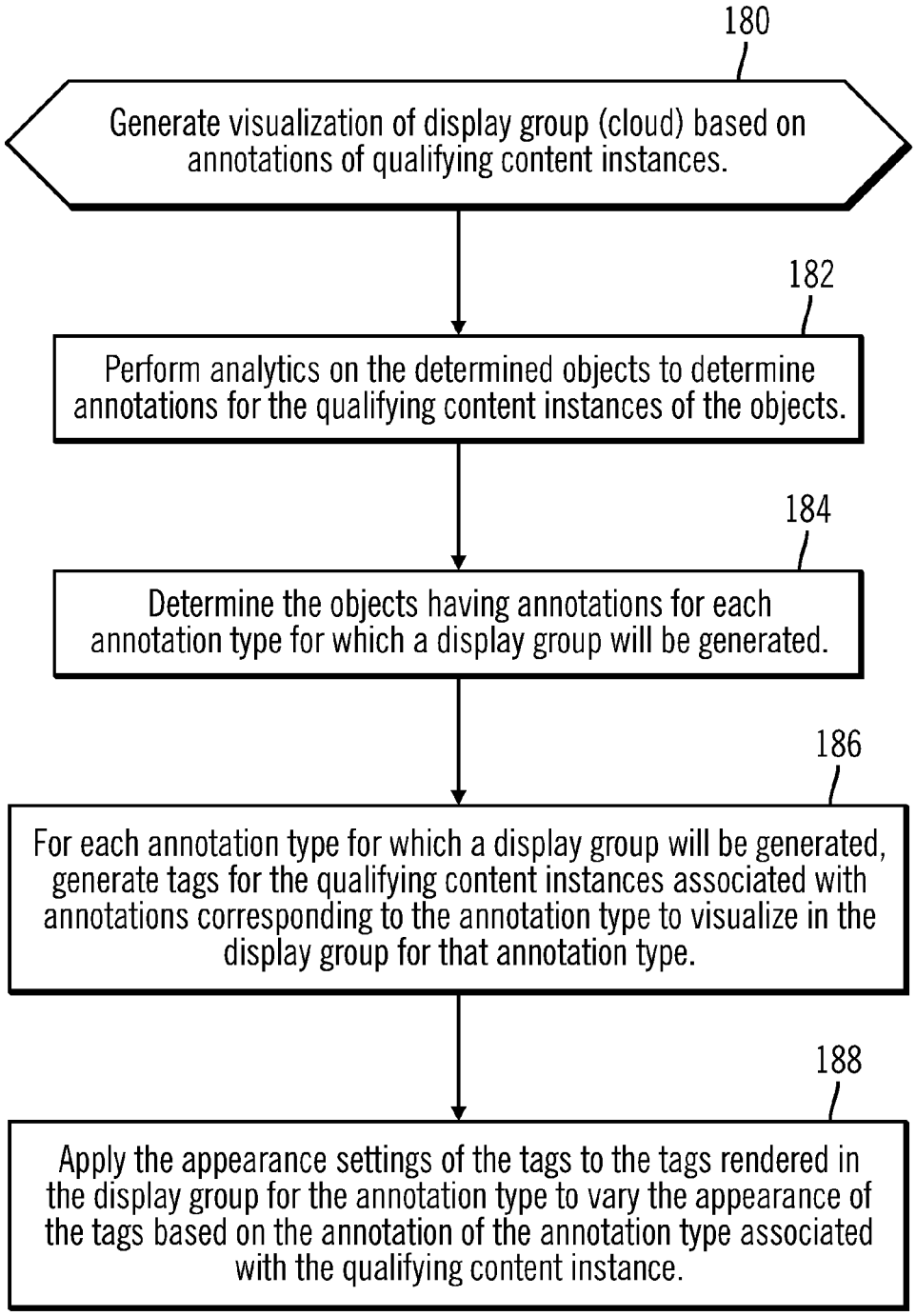

180
Generate visualization of display group (cloud) based on annotations of qualifying content instances.
182
Perform analytics on the determined objects to determine annotations for the qualifying content instances of the objects.
184
Determine the objects having annotations for each annotation type for which a display group will be generated.
186
For each annotation type for which a display group will be generated, generate tags for the qualifying content instances associated with annotations corresponding to the annotation type to visualize in the display group for that annotation type.
188
Apply the appearance settings of the tags to the tags rendered in the display group for the annotation type to vary the appearance of the tags based on the annotation of the annotation type associated with the qualifying content instance.

FIG. 8

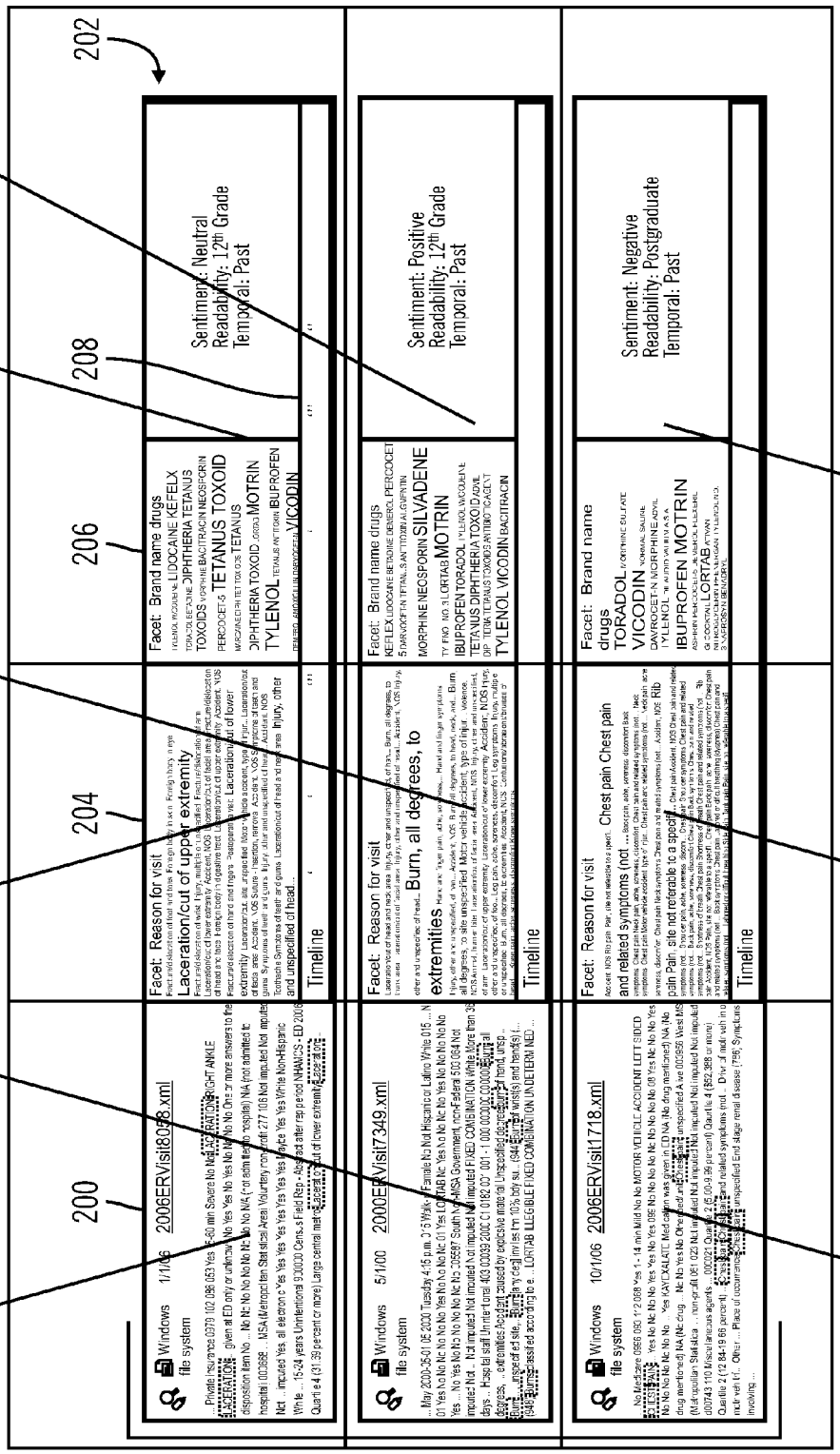
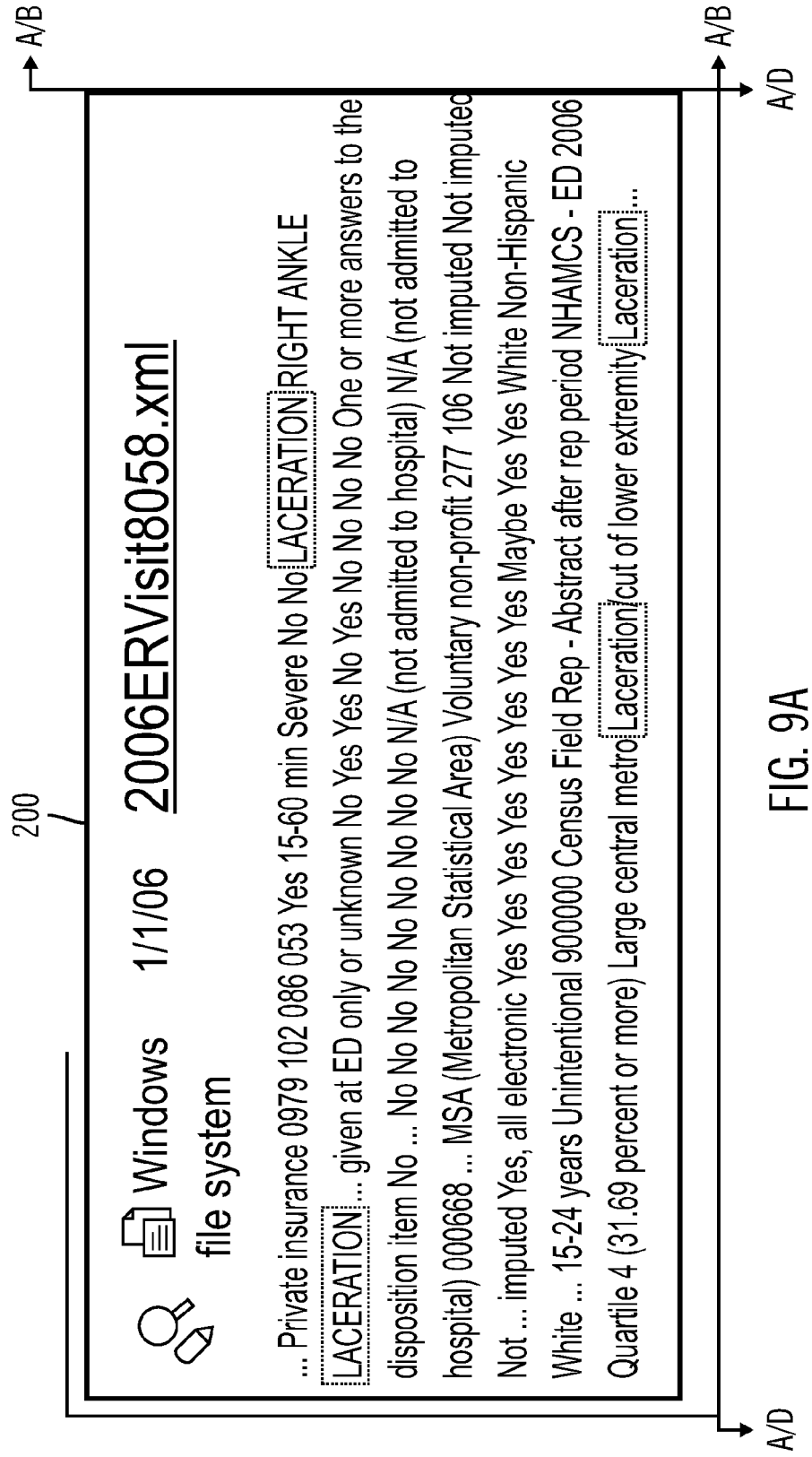


FIG. 9A
FIG. 9D
FIG. 9B
FIG. 9E
FIG. 9C
FIG. 9F
200
204
206
208
202
Windows file system
Facet: Reason for visit
Facet: Brand name drugs
Timeline
Sentiment: Neutral
Readability: 12th Grade
Temporal: Past
Sentiment: Positive
Readability: 12th Grade
Temporal: Past
Sentiment: Negative
Readability: Postgraduate
Temporal: Past
FIG. 9G
FIG. 9H
FIG. 9I
FIG. 9


200
A/B
A/D
A/B
A/D
Windows
file system
1/1/06
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... Private insurance 0979 102 086 053 Yes 15-60 min Severe No No LACERATION RIGHT ANKLE LACERATION ... given at ED only or unknown No Yes Yes No Yes No No No One or more answers to the disposition item No ... No No No No No No N/A (not admitted to hospital) N/A (not admitted to hospital) 000668 ... MSA (Metropolitan Statistical Area) Voluntary non-profit 277 106 Not imputed Not imputed Not ... imputed Yes, all electronic Yes Yes Yes Yes Yes Yes Maybe Yes Yes White Non-Hispanic White ... 15-24 years Unintentional 900000 Census Field Rep - Abstract after rep period NHAMCS - ED 2006 Quartile 4 (31.69 percent or more) Large central metro Laceration cut of lower extremity Laceration ...

FIG. 9A

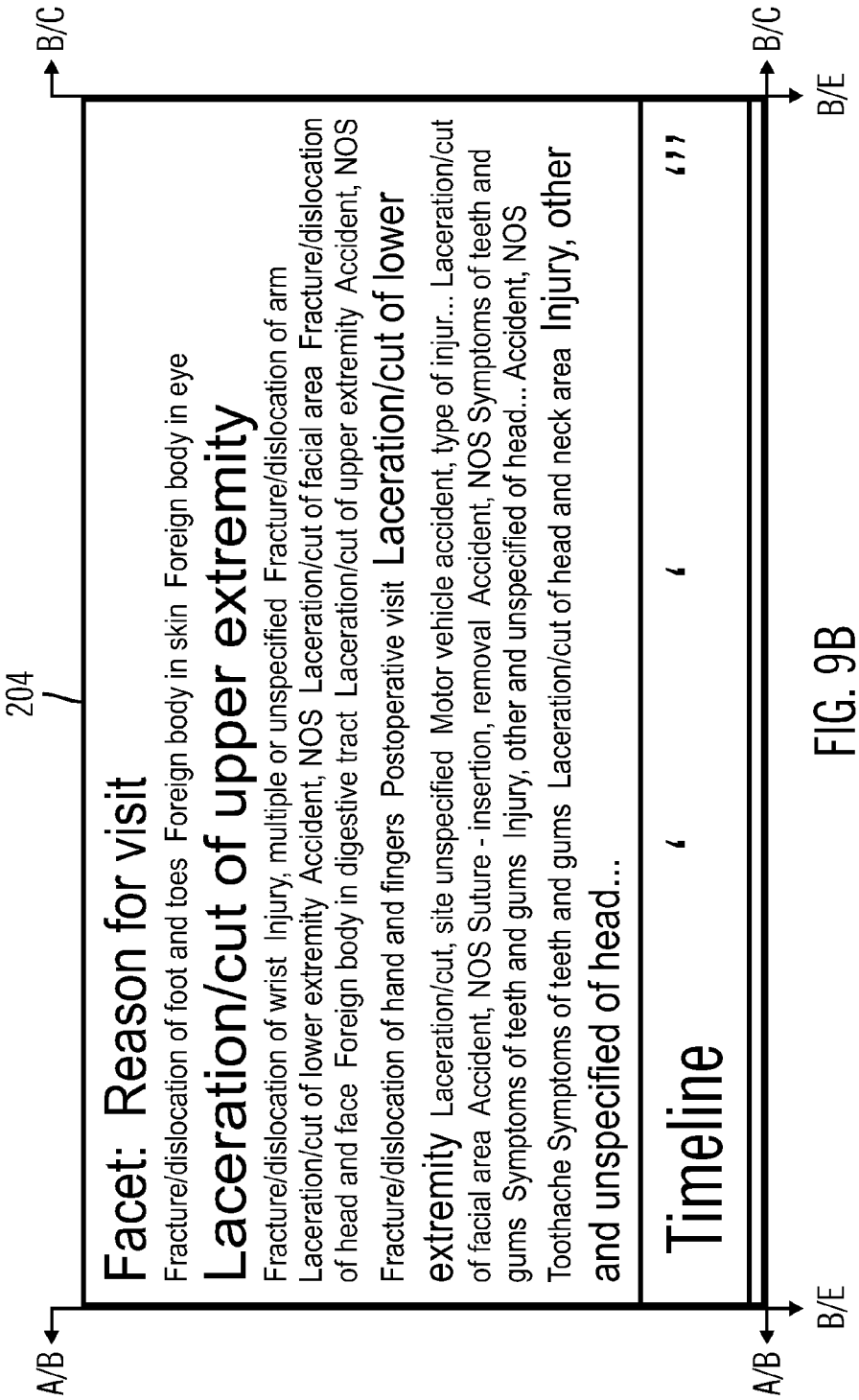
204
B/C
A/B
B/E
Facet: Reason for visit
Fracture/dislocation of foot and toes Foreign body in skin Foreign body in eye
Laceration/cut of upper extremity
Fracture/dislocation of wrist Injury, multiple or unspecified Fracture/dislocation of arm
Laceration/cut of lower extremity Accident, NOS Laceration/cut of facial area Fracture/dislocation
of head and face Foreign body in digestive tract Laceration/cut of upper extremity Accident, NOS
Fracture/dislocation of hand and fingers Postoperative visit Laceration/cut of lower
extremity Laceration/cut, site unspecified Motor vehicle accident, type of injur... Laceration/cut
of facial area Accident, NOS Suture - insertion, removal Accident, NOS Symptoms of teeth and
gums Symptoms of teeth and gums Injury, other and unspecified of head... Accident, NOS
Toothache Symptoms of teeth and gums Laceration/cut of head and neck area Injury, other
and unspecified of head...
Timeline
B/C
B/E
A/B
B/E

FIG. 9B

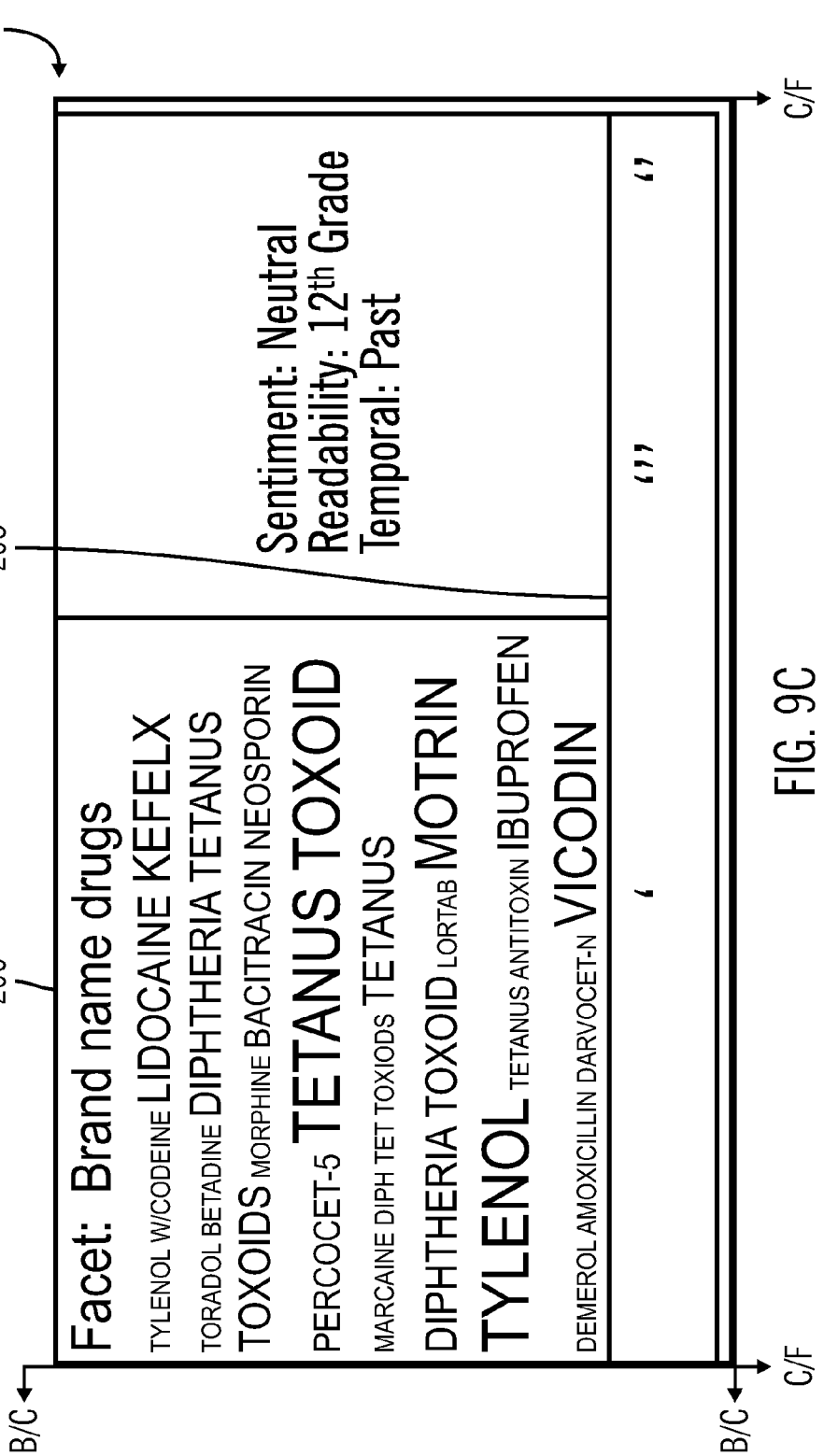
202
206
208
Facet: Brand name drugs
TYLENOL W/CODEINE LIDOCAINE KEFELX
TORADOL BETADINE DIPHTHERIA TETANUS
TOXOIDS MORPHINE BACITRACIN NEOSPORIN
PERCOCET-5 TETANUS TOXOID
MARCAINE DIPH TET TOXIODS TETANUS
DIPHTHERIA TOXOID LORTAB MOTRIN
TYLENOL TETANUS ANTITOXIN IBUPROFEN
DEMEROL AMOXICILLIN DARVOCET-N VICODIN
Sentiment: Neutral
Readability: 12th Grade
Temporal: Past
B/C
C/F
B/C
C/F

FIG. 9C

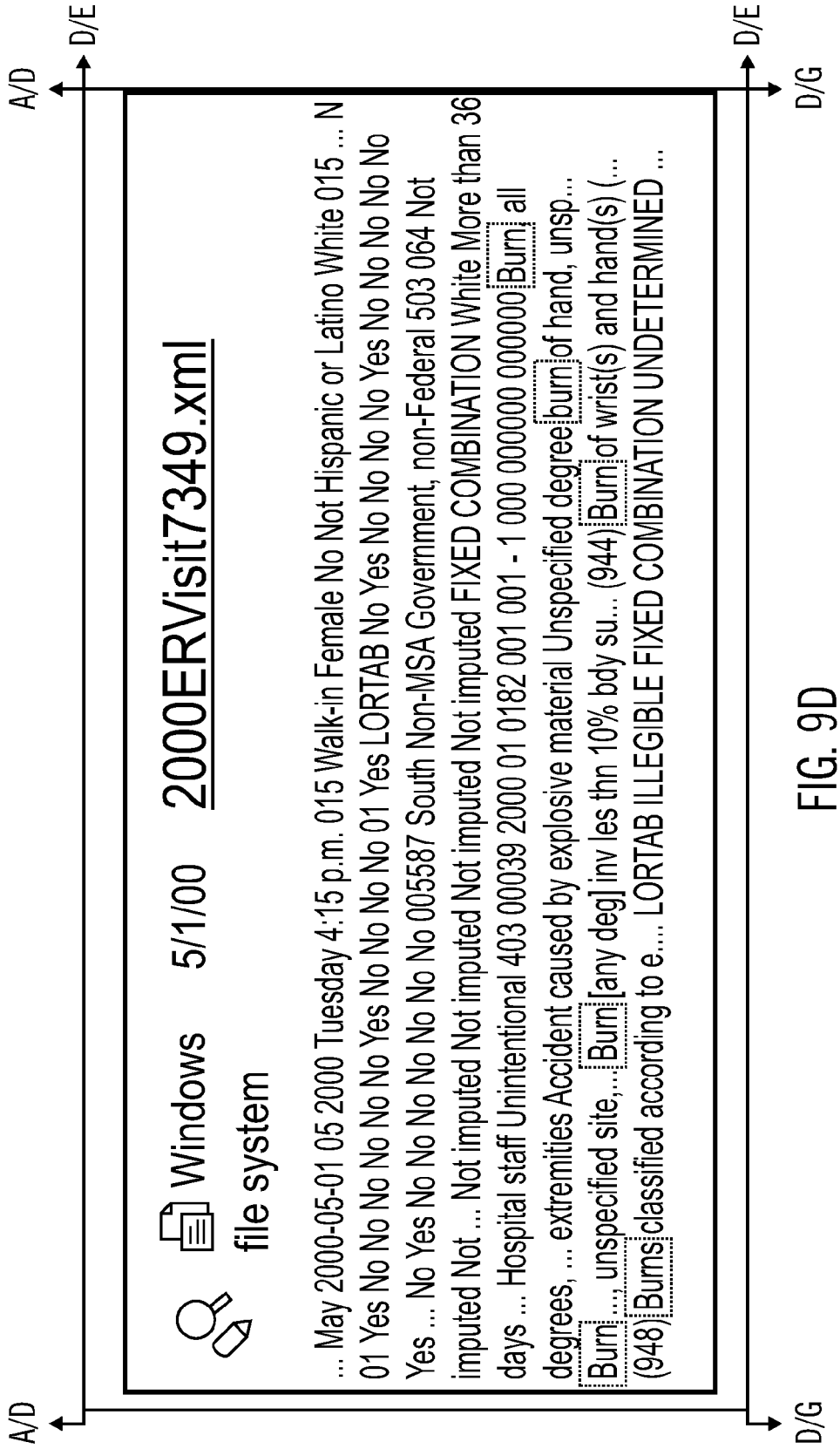
A/D
D/E
A/D
D/G
D/E
D/G
Windows
5/1/00
2000ERVisit7349.xml
file system
... May 2000-05-01 05 2000 Tuesday 4:15 p.m. 015 Walk-in Female No Not Hispanic or Latino White 015 ... N 01 Yes No No No No No Yes No No No 01 Yes LORTAB No Yes No No No No Yes No No No No Yes ... No Yes No No No No 005587 South Non-MSA Government, non-Federal 503 064 Not imputed Not ... Not imputed Not imputed Not imputed FIXED COMBINATION White More than 36 days ... Hospital staff Unintentional 403 00039 2000 01 0182 001 001 - 1 000 000000 000000 Burn, all degrees, ... extremities Accident caused by explosive material Unspecified degree burn of hand, unsp... Burn ..., unspecified site,... Burn [any deg] inv les thn 10% bdy su... (944) Burn of wrist(s) and hand(s) (... (948) Burns classified according to e.... LORTAB ILLEGIBLE FIXED COMBINATION UNDETERMINED ...

FIG. 9D

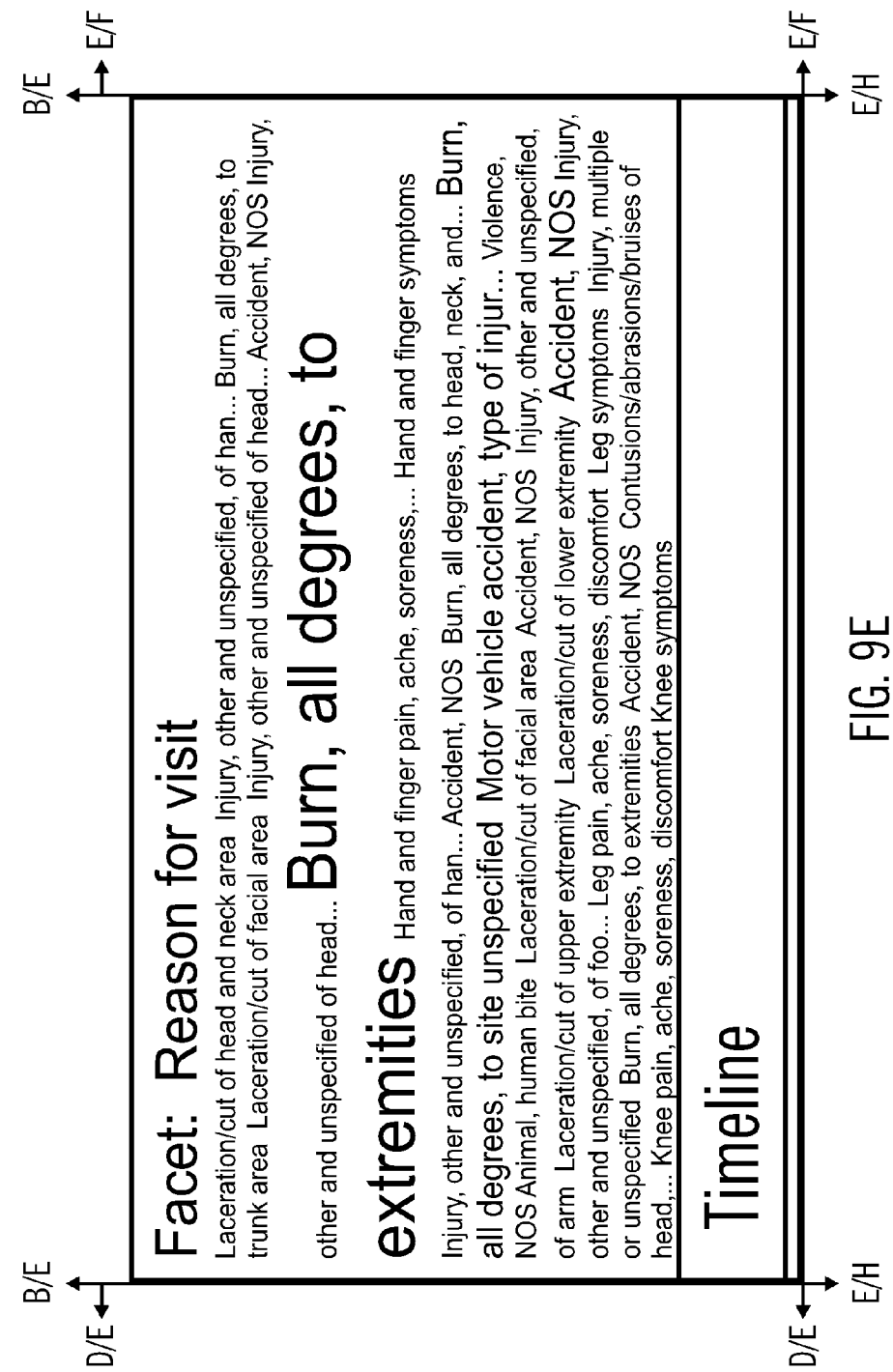
B/E
E/F
D/E
E/H
Facet: Reason for visit
Laceration/cut of head and neck area Injury, other and unspecified, of han... Burn, all degrees, to trunk area Laceration/cut of facial area Injury, other and unspecified of head... Accident, NOS Injury, other and unspecified of head... Burn, all degrees, to extremities Hand and finger pain, ache, soreness,... Hand and finger symptoms
Injury, other and unspecified, of han... Accident, NOS Burn, all degrees, to head, neck, and... Burn, all degrees, to site unspecified Motor vehicle accident, type of injur... Violence, NOS Animal, human bite Laceration/cut of facial area Accident, NOS Injury, other and unspecified, of arm Laceration/cut of upper extremity Laceration/cut of lower extremity Accident, NOS Injury, other and unspecified, of foo... Leg pain, ache, soreness, discomfort Leg symptoms Injury, multiple or unspecified Burn, all degrees, to extremities Accident, NOS Contusions/abrasions/bruises of head,... Knee pain, ache, soreness, discomfort Knee symptoms
Timeline

FIG. 9E

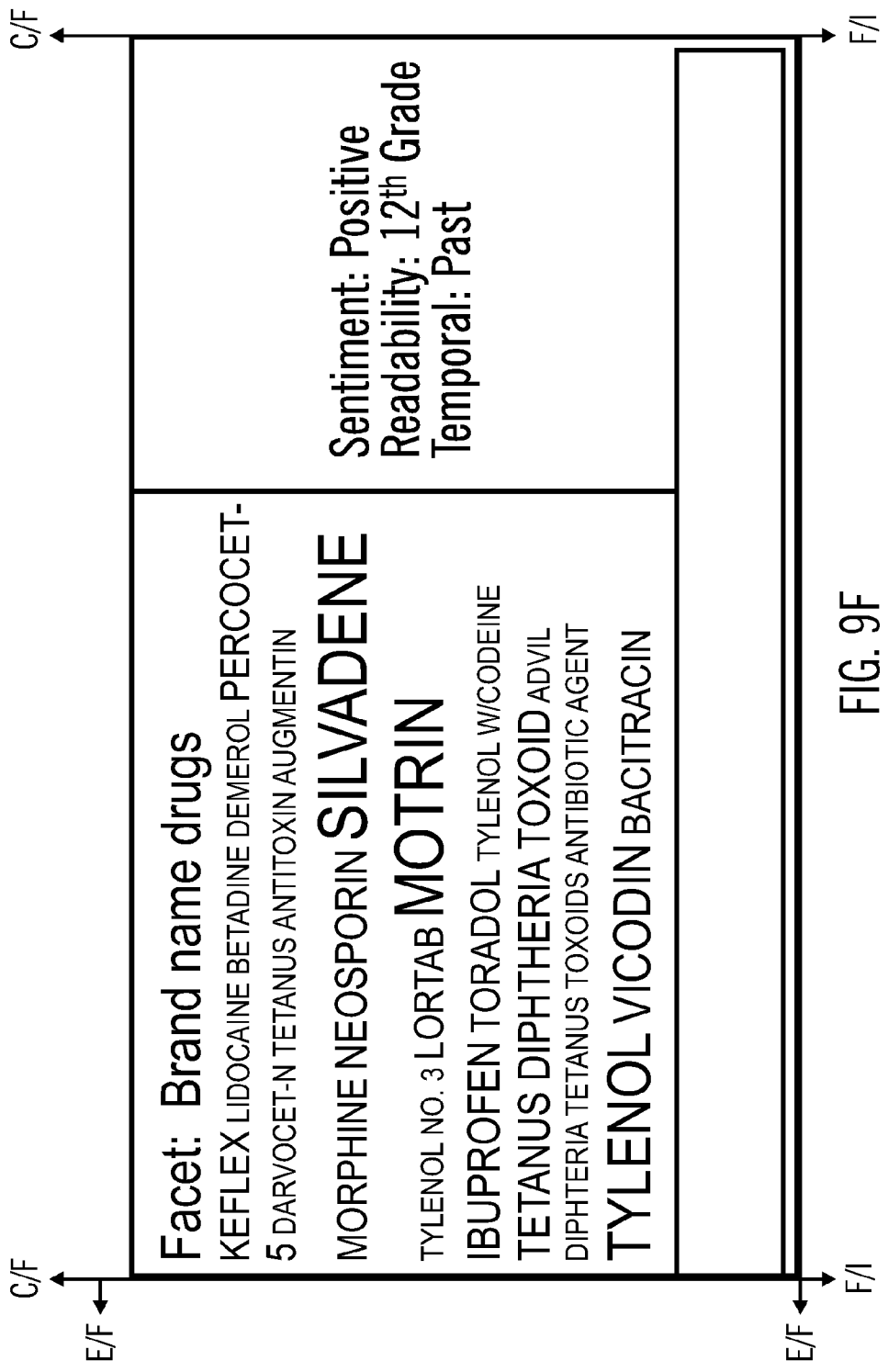
C/F
F/I
C/F
F/I
E/F
E/F
Facet: Brand name drugs
KEFLEX LIDOCAINE BETADINE DEMEROL PERCOCET-5 DARVOCET-N TETANUS ANTITOXIN AUGMENTIN
MORPHINE NEOSPORIN SILVADENE
TYLENOL NO. 3 LORTAB MOTRIN
IBUPROFEN TORADOL TYLENOL W/CODEINE
TETANUS DIPHTHERIA TOXOID ADVIL
DIPHTERIA TETANUS TOXOIDS ANTIBIOTIC AGENT
TYLENOL VICODIN BACITRACIN
Sentiment: Positive
Readability: 12th Grade
Temporal: Past

FIG. 9F

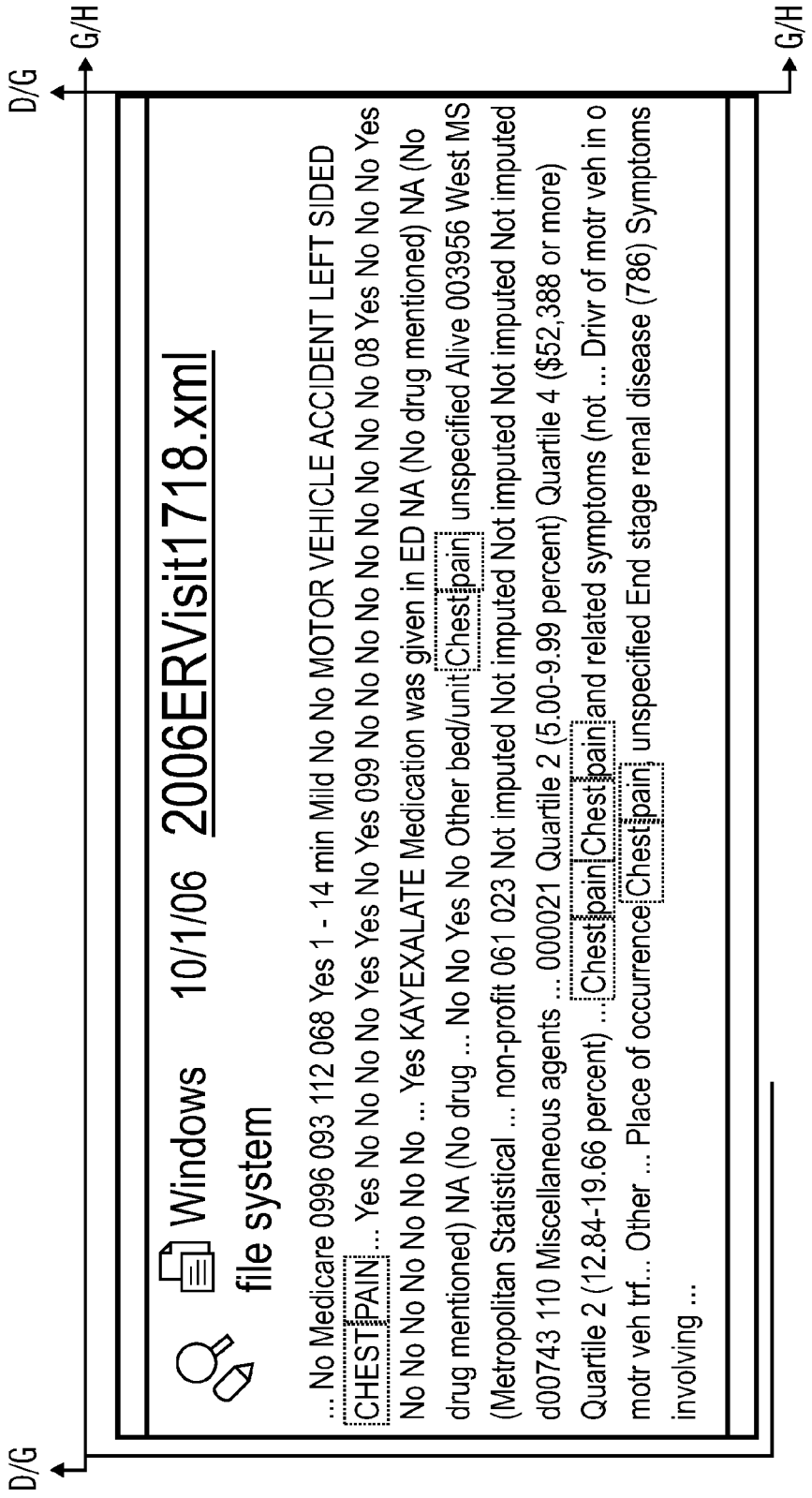
D/G
G/H
Windows
file system
10/1/06
2006ERVisit1718.xml
... No Medicare 0996 093 112 068 Yes 1 - 14 min Mild No No MOTOR VEHICLE ACCIDENT LEFT SIDED CHEST PAIN ... Yes No No No Yes Yes No Yes 099 No No No No No No No 08 Yes No No No Yes No No No No No No ... Yes KAYEXALATE Medication was given in ED NA (No drug mentioned) NA (No drug mentioned) NA (No drug ... No No Yes No Other bed/unit Chest pain unspecified Alive 003956 West MS (Metropolitan Statistical ... non-profit 061 023 Not imputed Not imputed Not imputed Not imputed d00743 110 Miscellaneous agents ... 000021 Quartile 2 (5.00-9.99 percent) Quartile 4 ($52,388 or more) Quartile 2 (12.84-19.66 percent) ... Chest pain Chest pain and related symptoms (not ... Drivr of motr veh in o motr veh trf... Other ... Place of occurrence Chest pain unspecified End stage renal disease (786) Symptoms involving ...

FIG. 9G

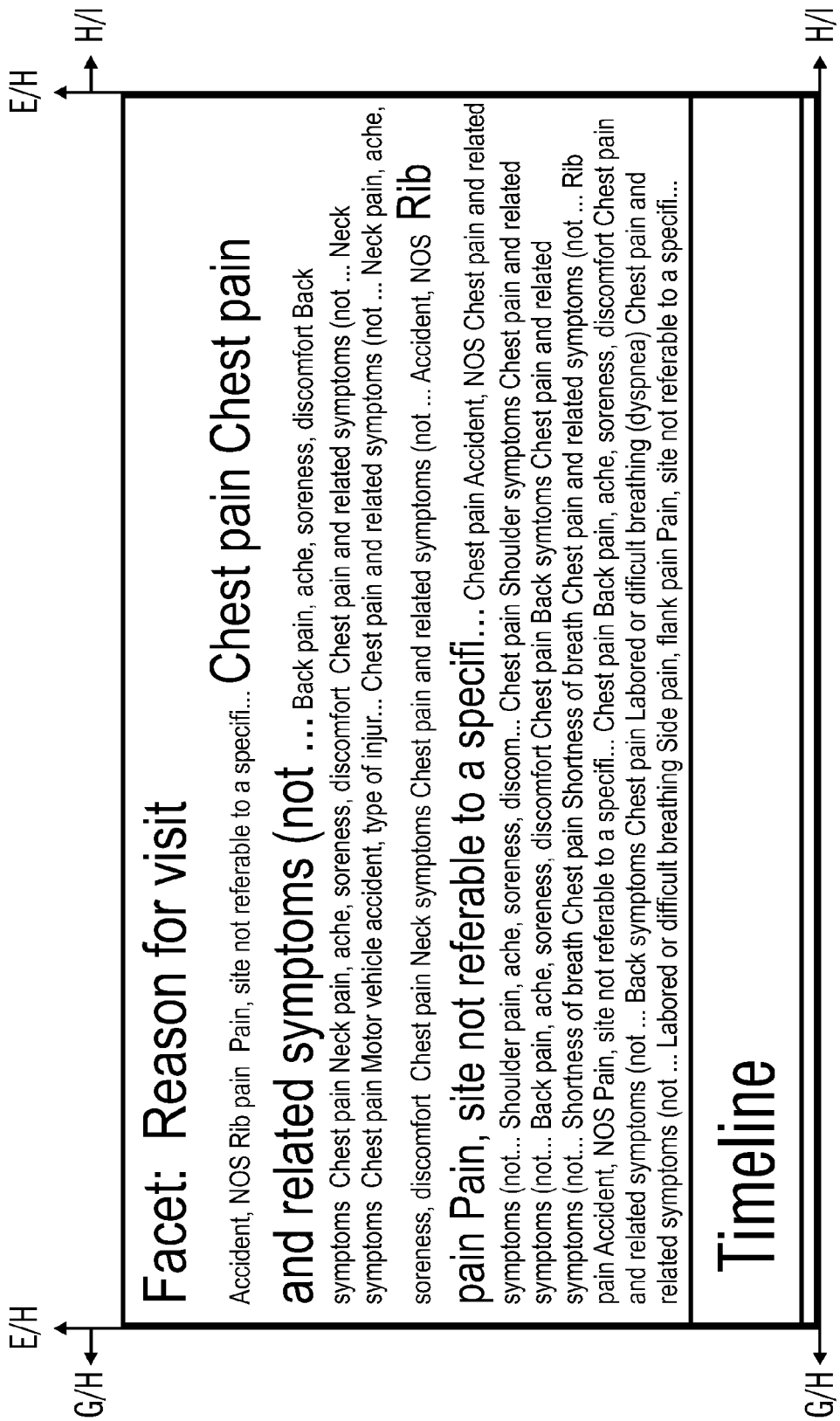
E/H
H/I
Facet: Reason for visit
Accident, NOS Rib pain Pain, site not referable to a specifi... Chest pain Chest pain
and related symptoms (not ... Back pain, ache, soreness, discomfort Back symptoms Chest pain Neck pain, ache, soreness, discomfort Chest pain and related symptoms (not ... Neck symptoms Chest pain Motor vehicle accident, type of injur... Chest pain and related symptoms (not ... Neck pain, ache, soreness, discomfort Chest pain Neck symptoms Chest pain and related symptoms (not ... Accident, NOS Rib
pain Pain, site not referable to a specifi... Chest pain Accident, NOS Chest pain and related symptoms (not... Shoulder pain, ache, soreness, discom... Chest pain Shoulder symptoms Chest pain and related symptoms (not... Back pain, ache, soreness, discomfort Chest pain Back symtoms Chest pain and related symptoms (not... Shortness of breath Chest pain Shortness of breath Chest pain and related symptoms (not ... Rib pain Accident, NOS Pain, site not referable to a specifi... Chest pain Back pain, ache, soreness, discomfort Chest pain and related symptoms (not ... Back symptoms Chest pain Labored or difficult breathing (dyspnea) Chest pain and related symptoms (not ... Labored or difficult breathing Side pain, flank pain Pain, site not referable to a specifi...
Timeline
G/H
E/H
H/I
G/H

FIG. 9H

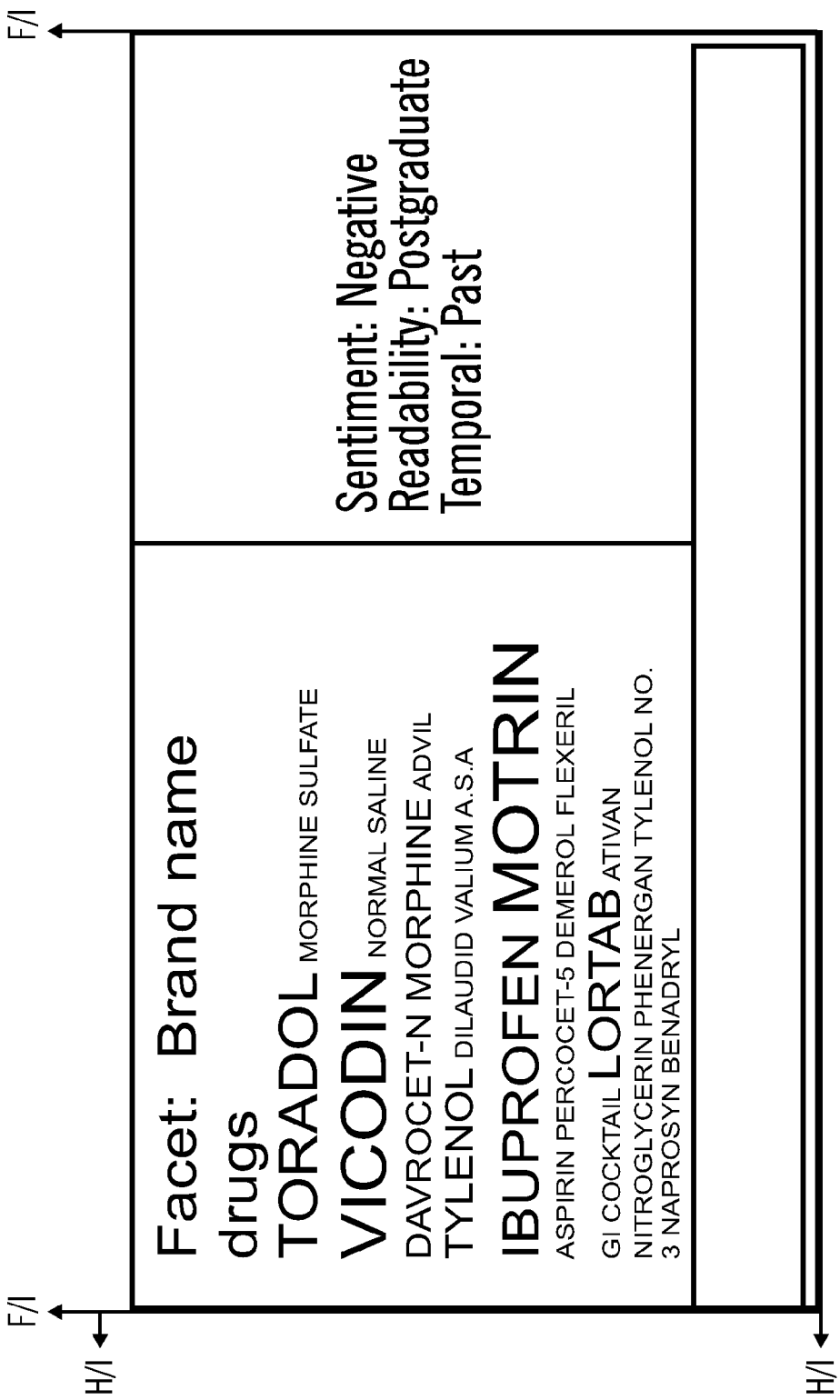
F/I
H/I
F/I
H/I
Facet: Brand name
drugs
TORADOL MORPHINE SULFATE
VICODIN NORMAL SALINE
DAVROCET-N MORPHINE ADVIL
TYLENOL DILAUDID VALIUM A.S.A
IBUPROFEN MOTRIN
ASPIRIN PERCOCET-5 DEMEROL FLEXERIL
GI COCKTAIL LORTAB ATIVAN
NITROGLYCERIN PHENERGAN TYLENOL NO.
3 NAPROSYN BENADRYL
Sentiment: Negative
Readability: Postgraduate
Temporal: Past

FIG. 9I

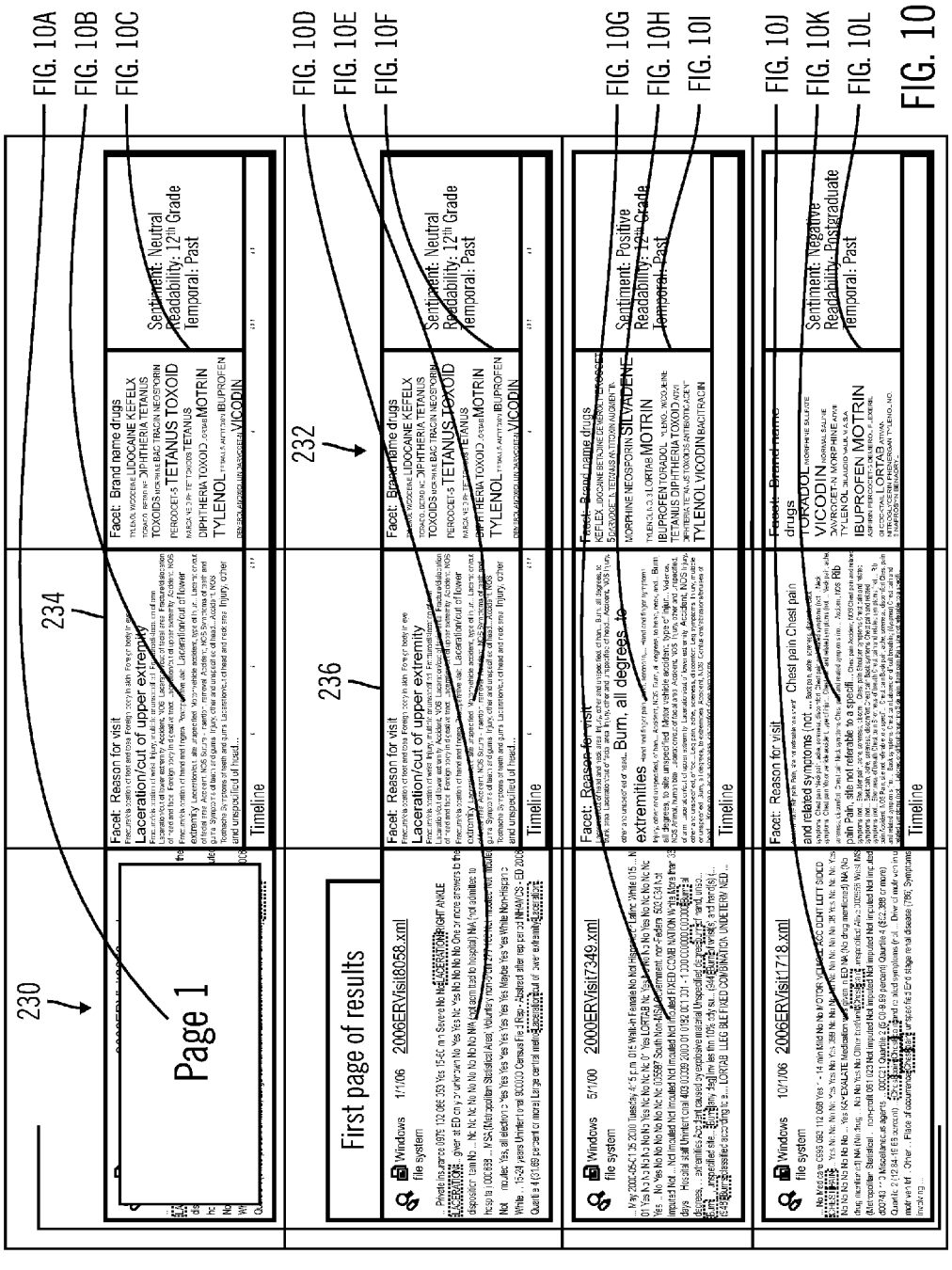

FIG. 10A
FIG. 10B
FIG. 10C
FIG. 10D
FIG. 10E
FIG. 10F
FIG. 10G
FIG. 10H
FIG. 10I
FIG. 10J
FIG. 10K
FIG. 10L

FIG. 10

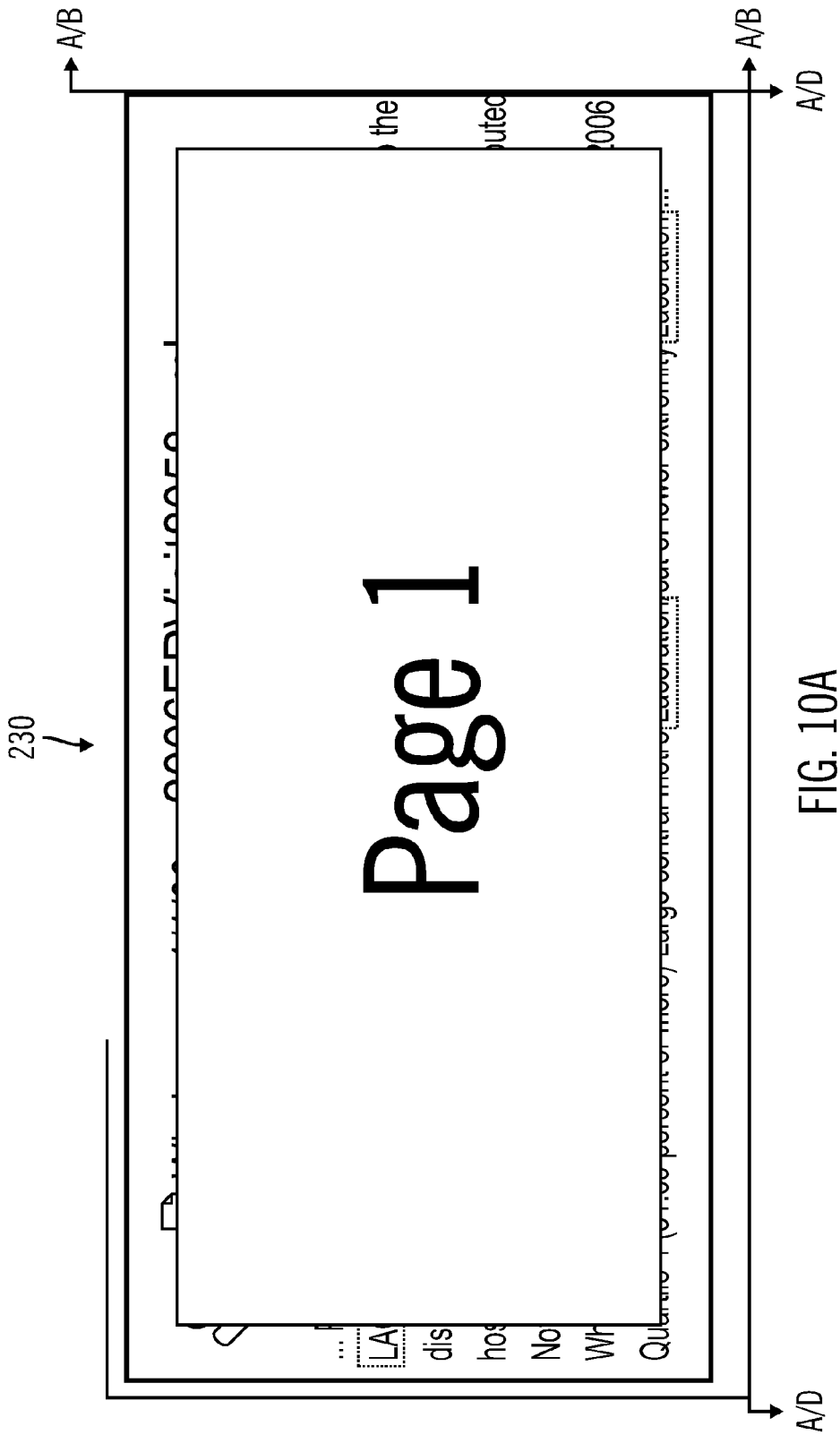

FIG. 10A

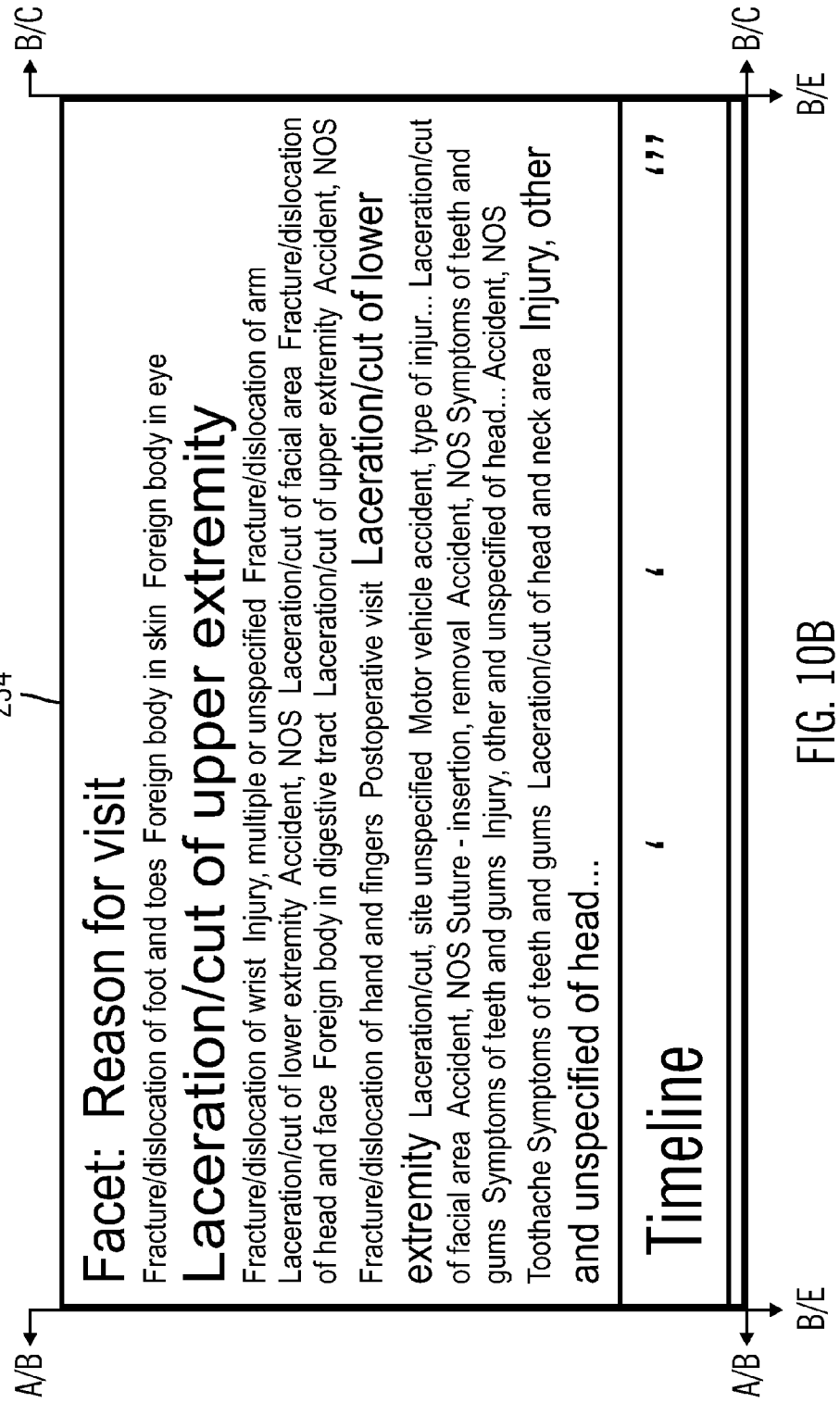
234
B/C
A/B
B/E
Facet: Reason for visit
Fracture/dislocation of foot and toes Foreign body in skin Foreign body in eye
Laceration/cut of upper extremity
Fracture/dislocation of wrist Injury, multiple or unspecified Fracture/dislocation of arm
Laceration/cut of lower extremity Accident, NOS Laceration/cut of facial area Fracture/dislocation
of head and face Foreign body in digestive tract Laceration/cut of upper extremity Accident, NOS
Fracture/dislocation of hand and fingers Postoperative visit Laceration/cut of lower
extremity Laceration/cut, site unspecified Motor vehicle accident, type of injur... Laceration/cut
of facial area Accident, NOS Suture - insertion, removal Accident, NOS Symptoms of teeth and
gums Symptoms of teeth and gums Injury, other and unspecified of head... Accident, NOS
Toothache Symptoms of teeth and gums Laceration/cut of head and neck area Injury, other
and unspecified of head...
Timeline
B/C
B/E
A/B

FIG. 10B

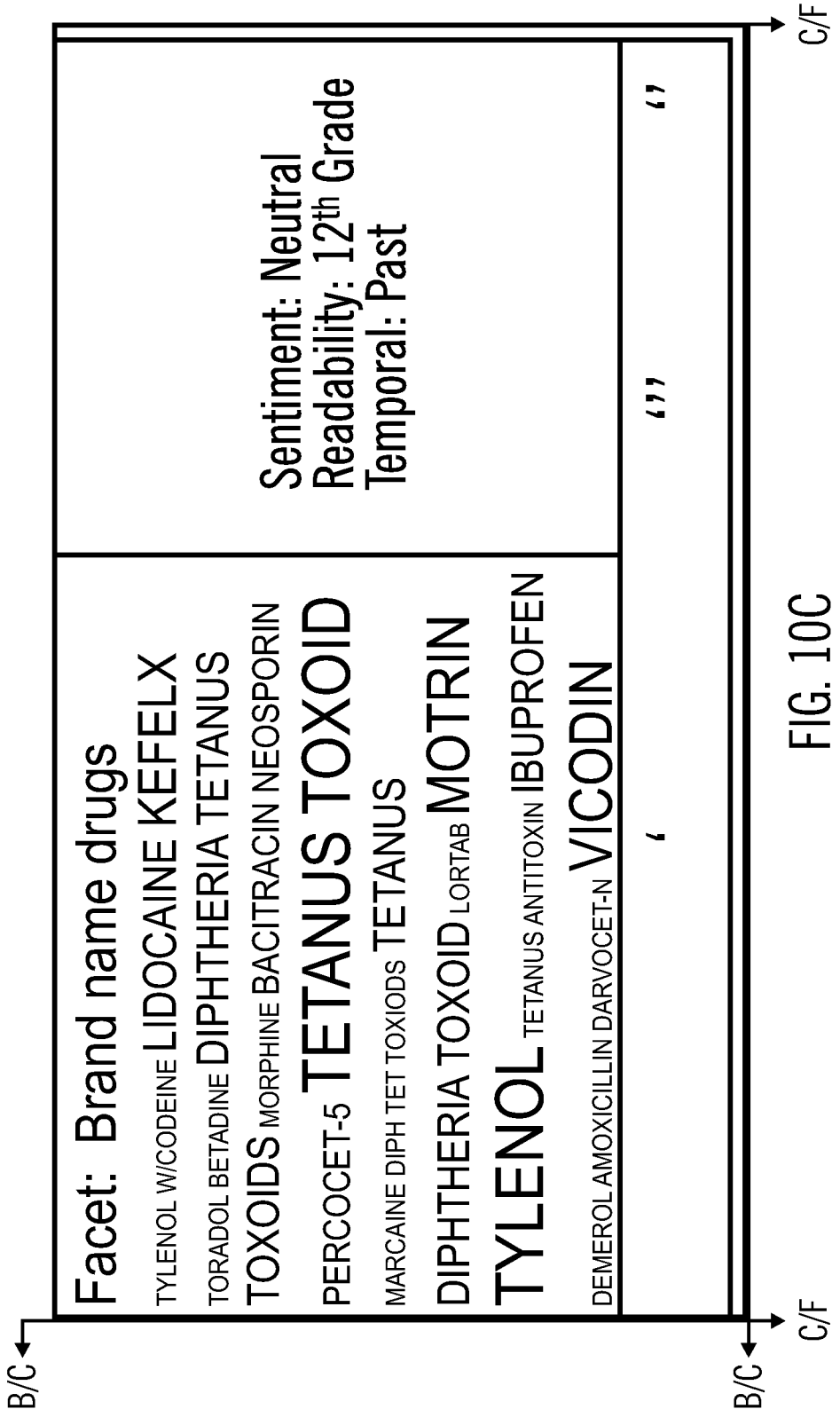
Facet: Brand name drugs
TYLENOL W/CODEINE LIDOCAINE KEFELX
TORADOL BETADINE DIPHTHERIA TETANUS
TOXOIDS MORPHINE BACITRACIN NEOSPORIN
PERCOCET-5 TETANUS TOXOID
MARCAINE DIPH TET TOXIODS TETANUS
DIPHTHERIA TOXOID LORTAB MOTRIN
TYLENOL TETANUS ANTITOXIN IBUPROFEN
DEMEROL AMOXICILLIN DARVOCET-N VICODIN
Sentiment: Neutral
Readability: 12th Grade
Temporal: Past
B/C
C/F
B/C
C/F

FIG. 10C

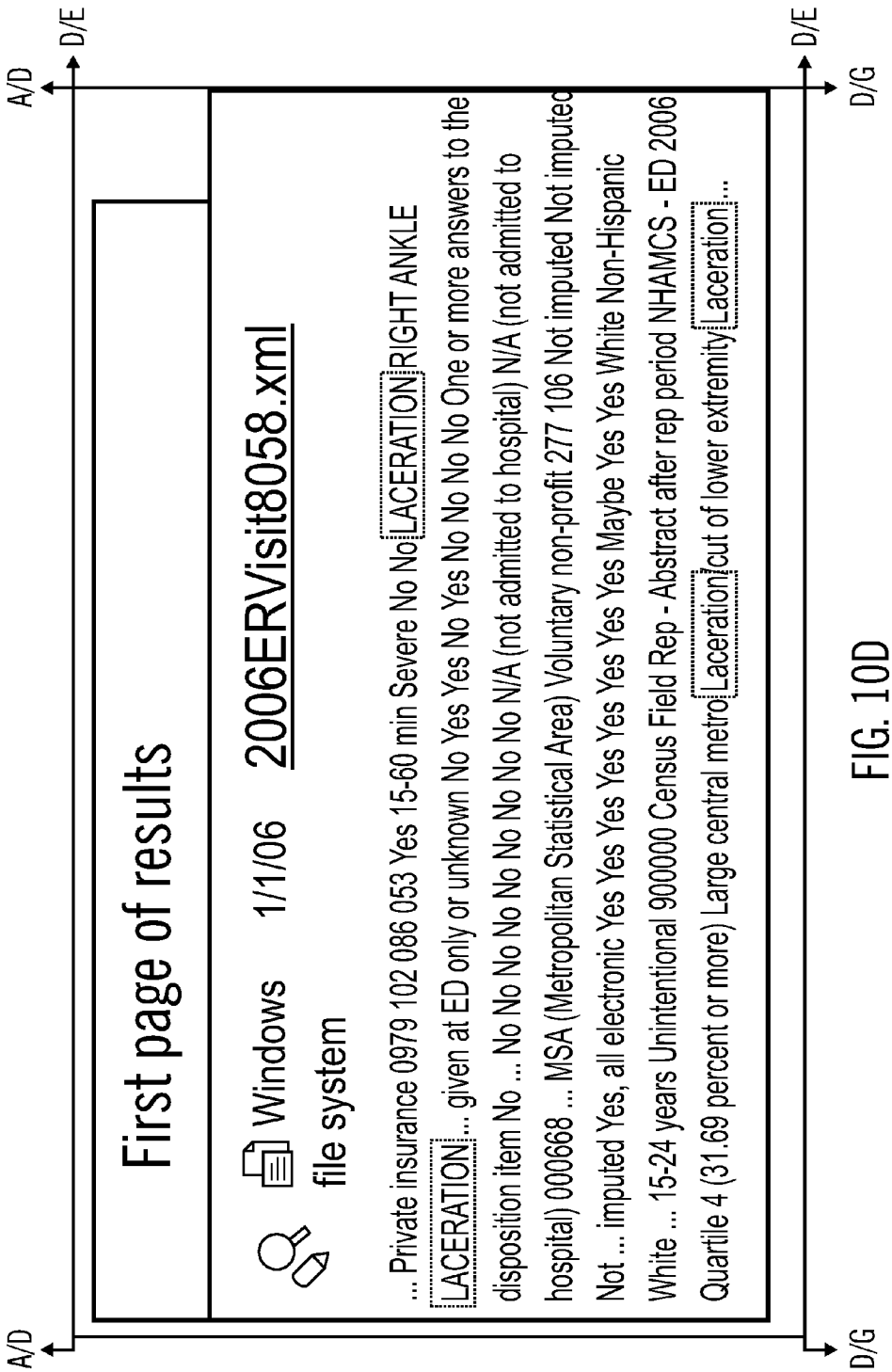
A/D
D/E
A/D
D/E
D/G
D/G
First page of results
Windows
file system
1/1/06
2006ERVisit8058.xml
... Private insurance 0979 102 086 053 Yes 15-60 min Severe No No LACERATION RIGHT ANKLE LACERATION ... given at ED only or unknown No Yes Yes No Yes No No No One or more answers to the disposition item No ... No No No No No No N/A (not admitted to hospital) N/A (not admitted to hospital) 000668 ... MSA (Metropolitan Statistical Area) Voluntary non-profit 277 106 Not imputed Not imputed Not ... imputed Yes, all electronic Yes Yes Yes Yes Yes Yes Maybe Yes Yes White Non-Hispanic White ... 15-24 years Unintentional 900000 Census Field Rep - Abstract after rep period NHAMCS - ED 2006 Quartile 4 (31.69 percent or more) Large central metro Laceration cut of lower extremity Laceration ...

FIG. 10D

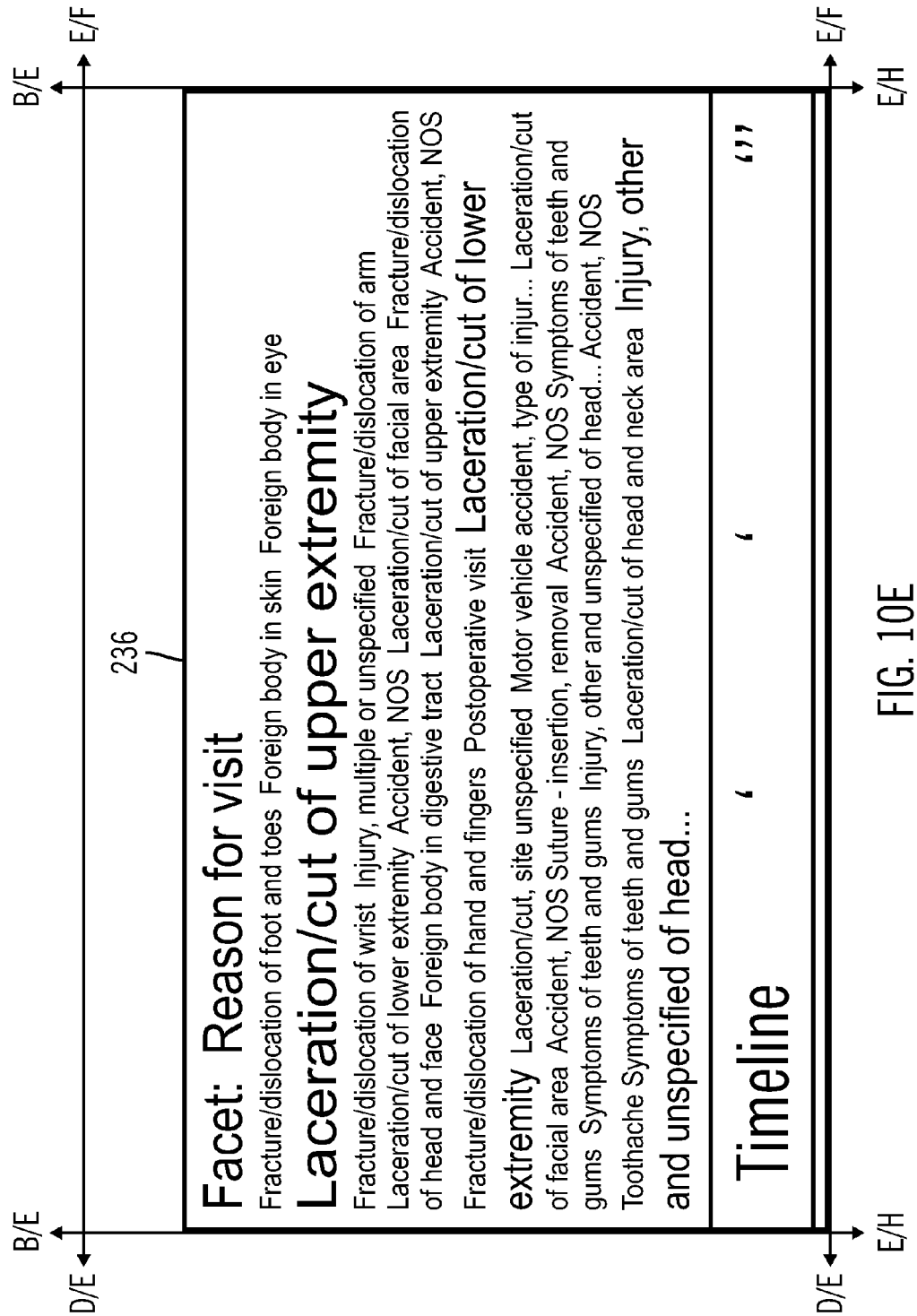
B/E
E/F
D/E
E/H
236
Facet: Reason for visit
Fracture/dislocation of foot and toes Foreign body in skin Foreign body in eye
Laceration/cut of upper extremity
Fracture/dislocation of wrist Injury, multiple or unspecified Fracture/dislocation of arm
Laceration/cut of lower extremity Accident, NOS Laceration/cut of facial area Fracture/dislocation
of head and face Foreign body in digestive tract Laceration/cut of upper extremity Accident, NOS
Fracture/dislocation of hand and fingers Postoperative visit Laceration/cut of lower
extremity Laceration/cut, site unspecified Motor vehicle accident, type of injur... Laceration/cut
of facial area Accident, NOS Suture - insertion, removal Accident, NOS Symptoms of teeth and
gums Symptoms of teeth and gums Injury, other and unspecified of head... Accident, NOS
Toothache Symptoms of teeth and gums Laceration/cut of head and neck area Injury, other
and unspecified of head...
Timeline

FIG. 10E

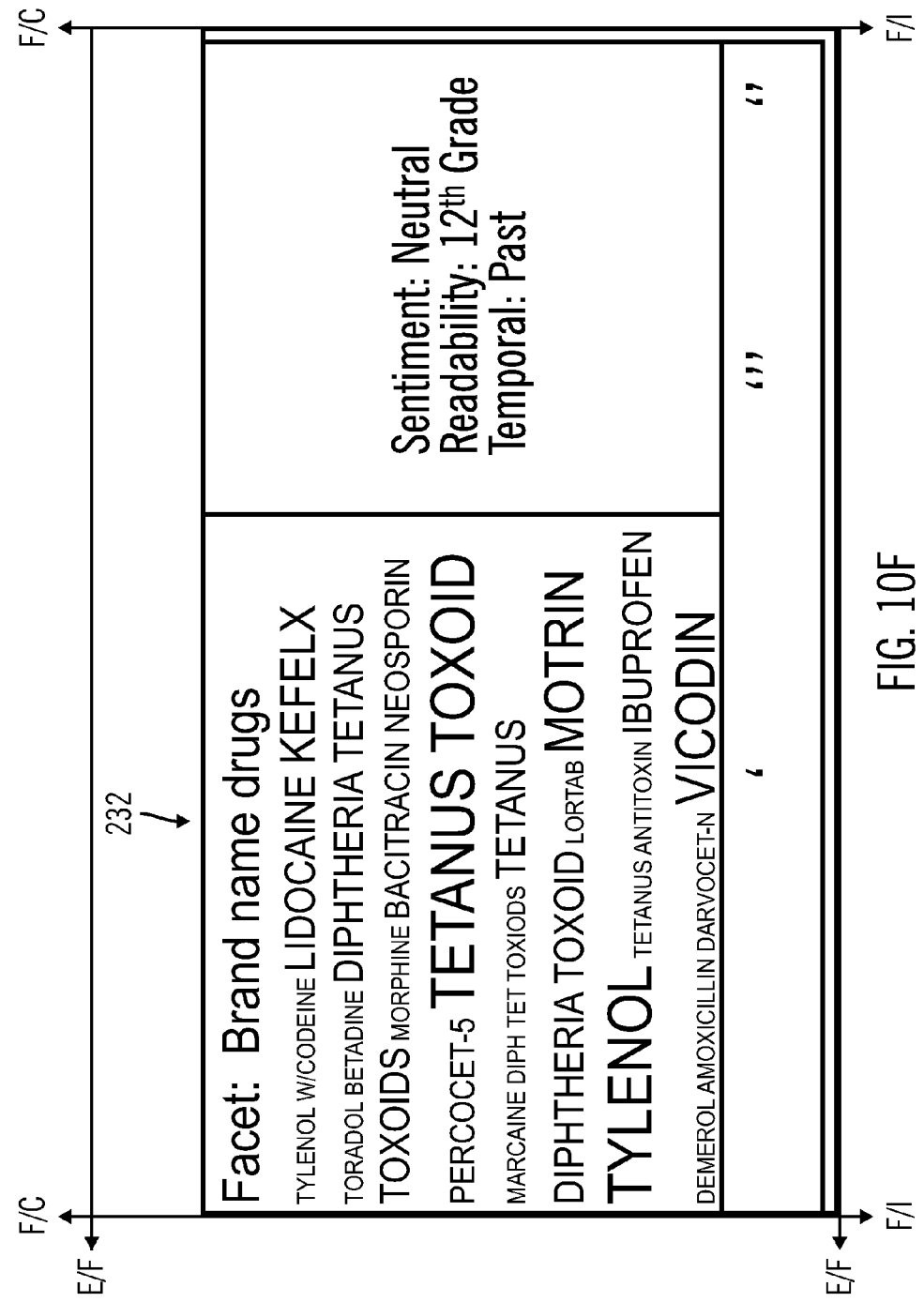
F/C
E/F
232
Facet: Brand name drugs
TYLENOL W/CODEINE LIDOCAINE KEFELX
TORADOL BETADINE DIPHTHERIA TETANUS
TOXOIDS MORPHINE BACITRACIN NEOSPORIN
PERCOCET-5 TETANUS TOXOID
MARCAINE DIPH TET TOXIODS TETANUS
DIPHTHERIA TOXOID LORTAB MOTRIN
TYLENOL TETANUS ANTITOXIN IBUPROFEN
DEMEROL AMOXICILLIN DARVOCET-N VICODIN
Sentiment: Neutral
Readability: 12th Grade
Temporal: Past
F/I
E/F

FIG. 10F

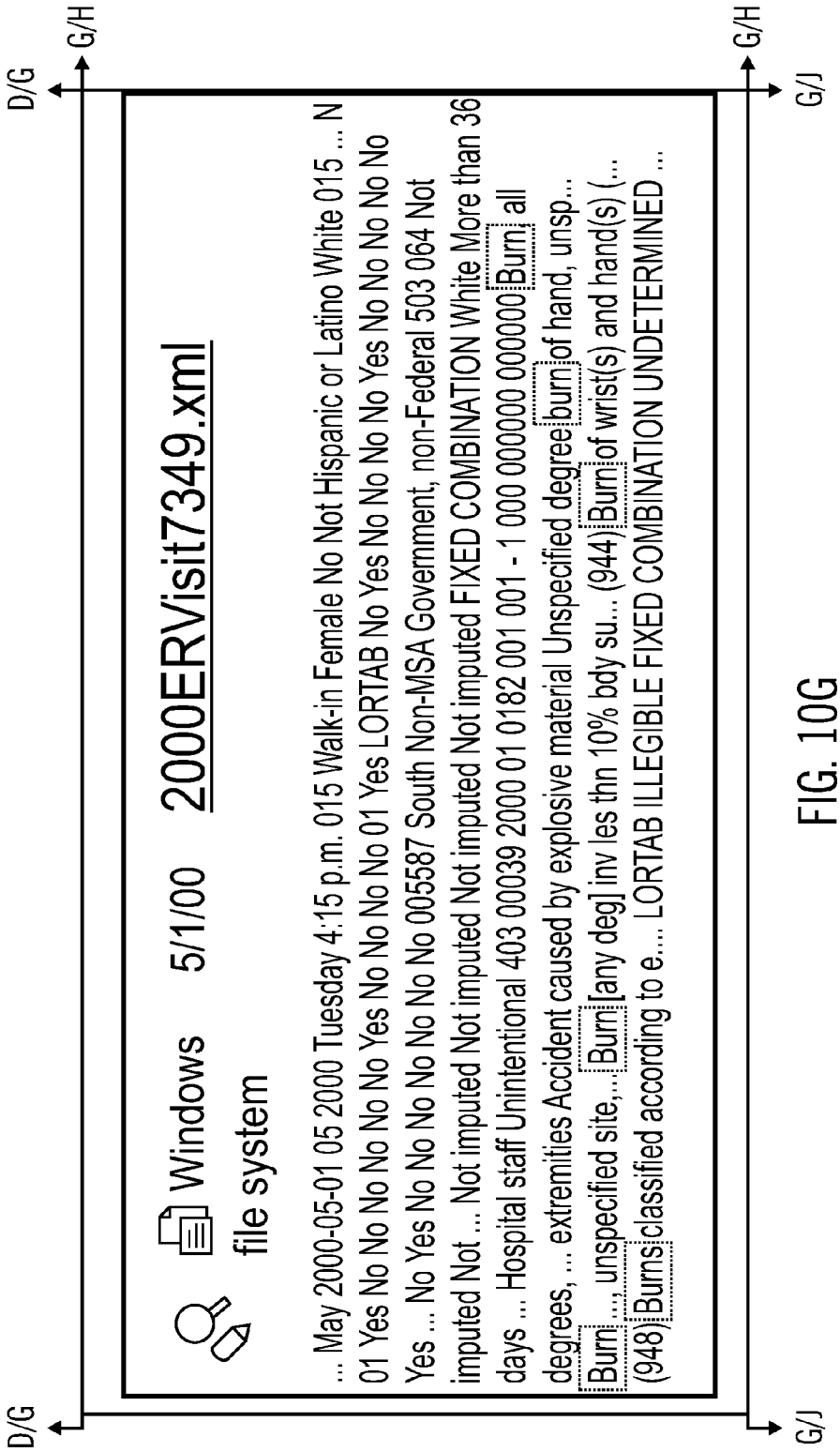
D/G
G/H
D/G
G/J
G/H
G/J
Windows
file system
5/1/00
2000ERVisit7349.xml
... May 2000-05-01 05 2000 Tuesday 4:15 p.m. 015 Walk-in Female No Not Hispanic or Latino White 015 ... N 01 Yes No No No No Yes No No No 01 Yes LORTAB No Yes No No No Yes No No No No No Yes ... No Yes No No No No 005587 South Non-MSA Government, non-Federal 503 064 Not imputed Not ... Not imputed Not imputed Not imputed FIXED COMBINATION White More than 36 days ... Hospital staff Unintentional 403 00039 2000 01 0182 001 001 - 1 000 000000 000000 Burn; all degrees, ... extremities Accident caused by explosive material Unspecified degree burn of hand, unsp... Burn ..., unspecified site,... Burn [any deg] inv les thn 10% bdy su... (944) Burn of wrist(s) and hand(s) (... (948) Burns classified according to e.... LORTAB ILLEGIBLE FIXED COMBINATION UNDETERMINED ...

FIG. 10G

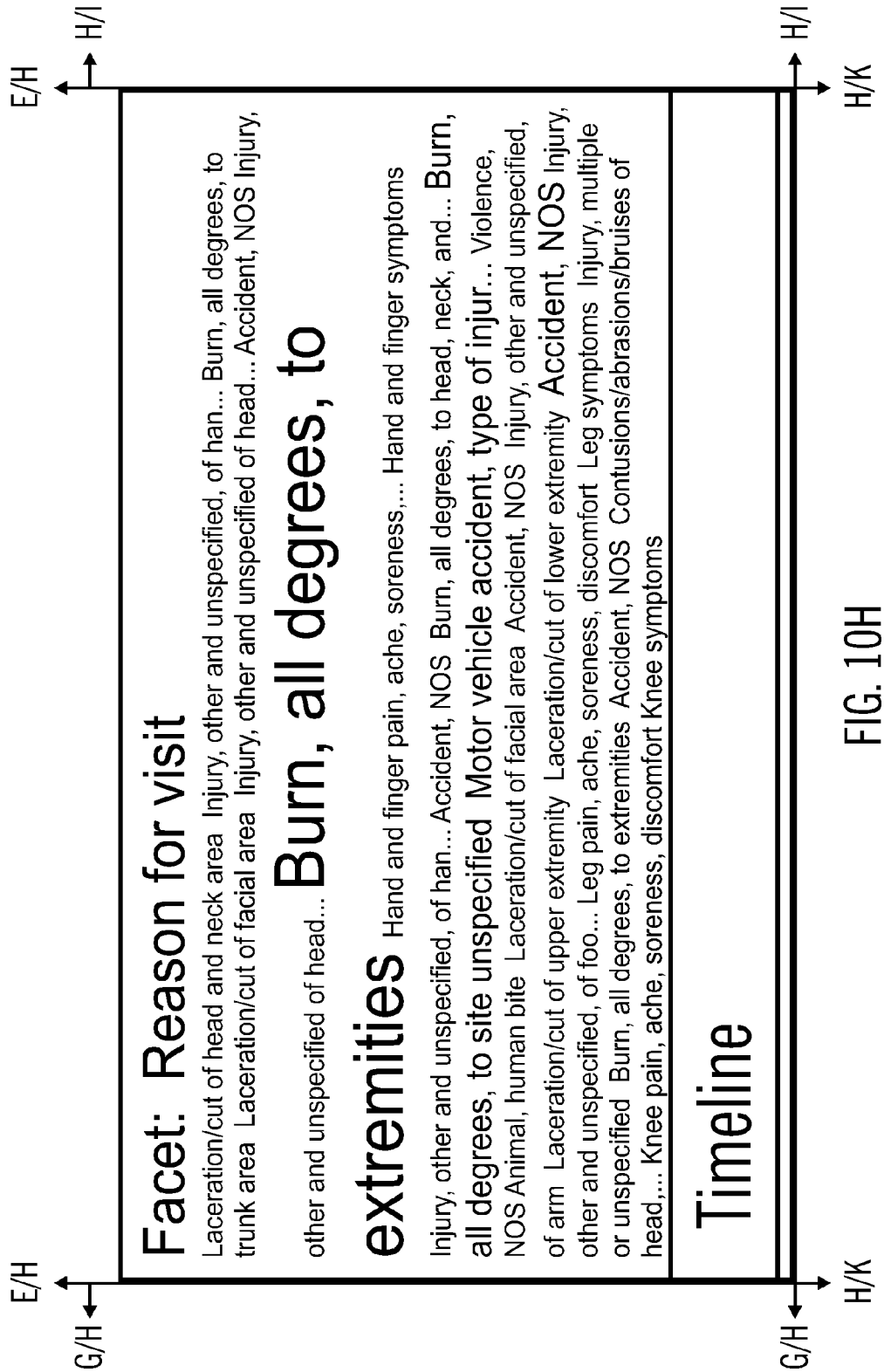
E/H
H/I
E/H
G/H
Facet: Reason for visit
Laceration/cut of head and neck area Injury, other and unspecified, of han... Burn, all degrees, to trunk area Laceration/cut of facial area Injury, other and unspecified of head... Accident, NOS Injury,
other and unspecified of head... Burn, all degrees, to extremities Hand and finger pain, ache, soreness,... Hand and finger symptoms
Injury, other and unspecified, of han... Accident, NOS Burn, all degrees, to head, neck, and... Burn, all degrees, to site unspecified Motor vehicle accident, type of injur... Violence, NOS Animal, human bite Laceration/cut of facial area Accident, NOS Injury, other and unspecified, of arm Laceration/cut of upper extremity Laceration/cut of lower extremity Accident, NOS Injury, other and unspecified, of foo... Leg pain, ache, soreness, discomfort Leg symptoms Injury, multiple or unspecified Burn, all degrees, to extremities Accident, NOS Contusions/abrasions/bruises of head,... Knee pain, ache, soreness, discomfort Knee symptoms
Timeline
H/I
H/K
G/H
H/K

FIG. 10H

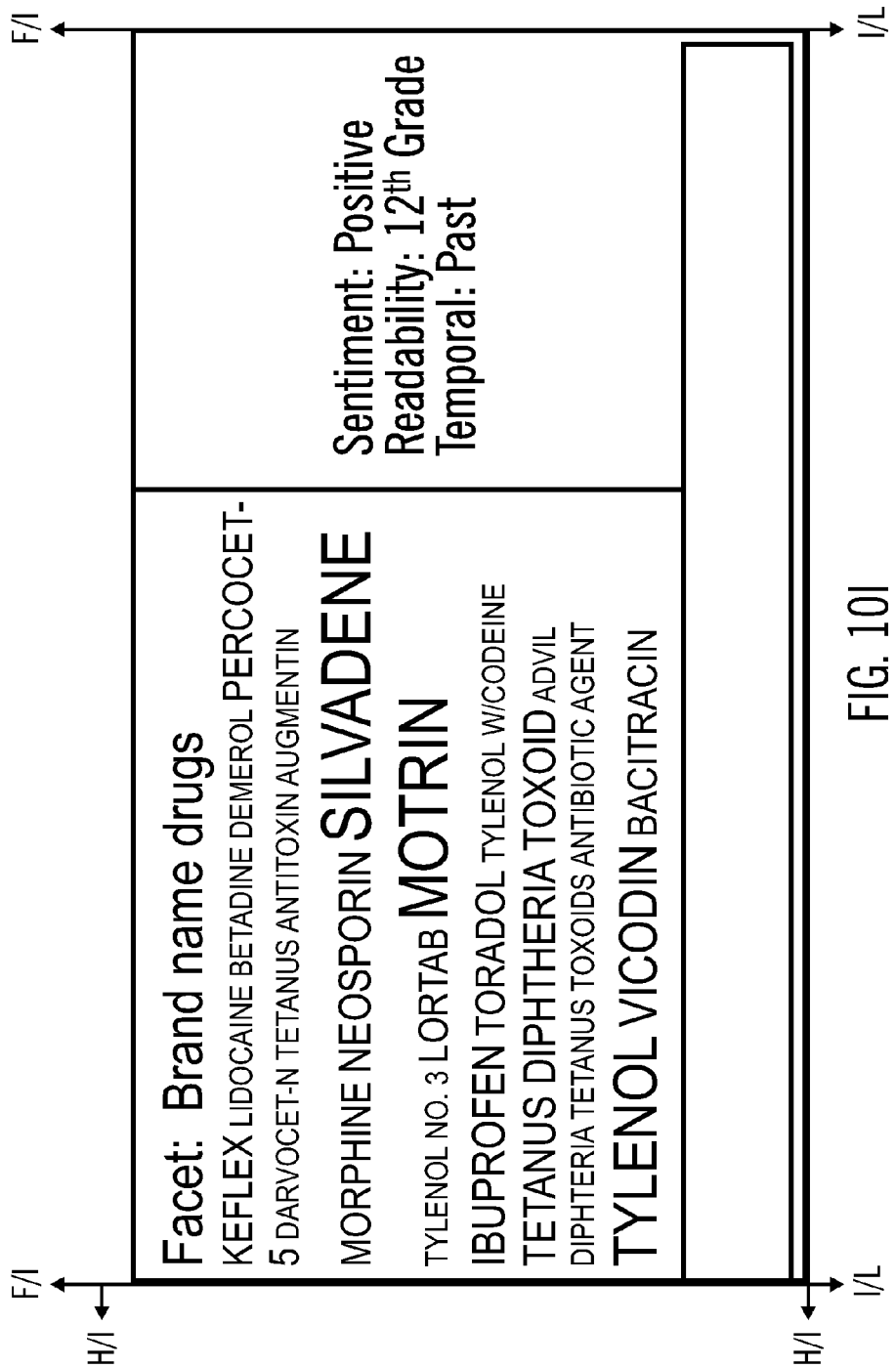
F/I
I/L
H/I
F/I
I/L
H/I
Facet: Brand name drugs
KEFLEX LIDOCAINE BETADINE DEMEROL PERCOCET-5 DARVOCET-N TETANUS ANTITOXIN AUGMENTIN
MORPHINE NEOSPORIN SILVADENE
TYLENOL NO. 3 LORTAB MOTRIN
IBUPROFEN TORADOL TYLENOL W/CODEINE
TETANUS DIPHTHERIA TOXOID ADVIL
DIPHTERIA TETANUS TOXOIDS ANTIBIOTIC AGENT
TYLENOL VICODIN BACITRACIN
Sentiment: Positive
Readability: 12th Grade
Temporal: Past

FIG. 10I

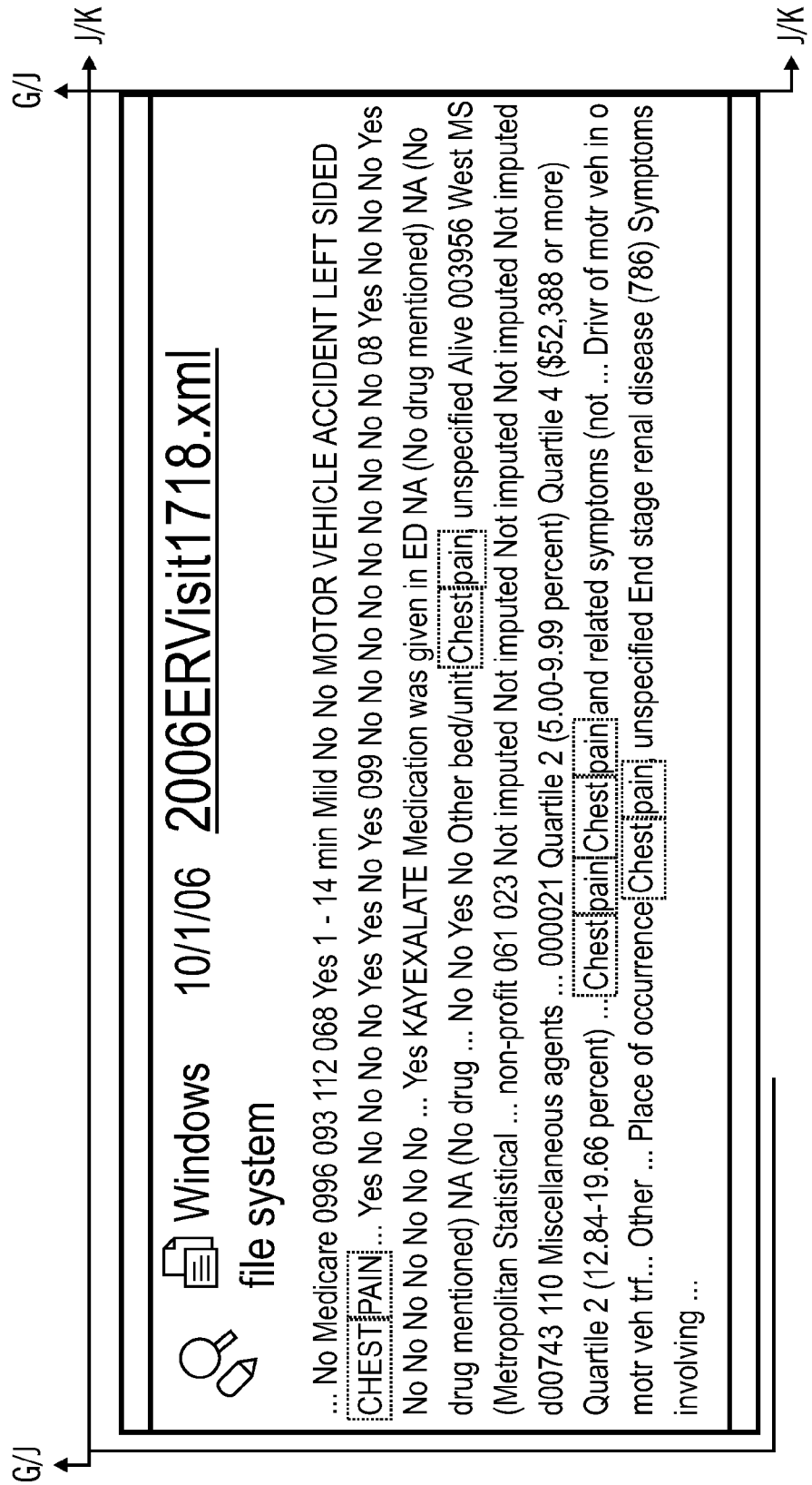
G/J
J/K
Windows
file system
10/1/06
2006ERVisit1718.xml
... No Medicare 0996 093 112 068 Yes 1 - 14 min Mild No No MOTOR VEHICLE ACCIDENT LEFT SIDED CHEST PAIN ... Yes No No No Yes Yes No Yes 099 No No No No No No No 08 Yes No No No Yes No No No No No No ... Yes KAYEXALATE Medication was given in ED NA (No drug mentioned) NA (No drug mentioned) NA (No drug ... No No Yes No Other bed/unit Chest pain unspecified Alive 003956 West MS (Metropolitan Statistical ... non-profit 061 023 Not imputed Not imputed Not imputed Not imputed Not imputed d00743 110 Miscellaneous agents ... 000021 Quartile 2 (5.00-9.99 percent) Quartile 4 ($52,388 or more) Quartile 2 (12.84-19.66 percent) ... Chest pain Chest pain and related symptoms (not ... Drivr of motr veh in o motr veh trf... Other ... Place of occurrence Chest pain unspecified End stage renal disease (786) Symptoms involving ...
G/J
J/K

FIG. 10J

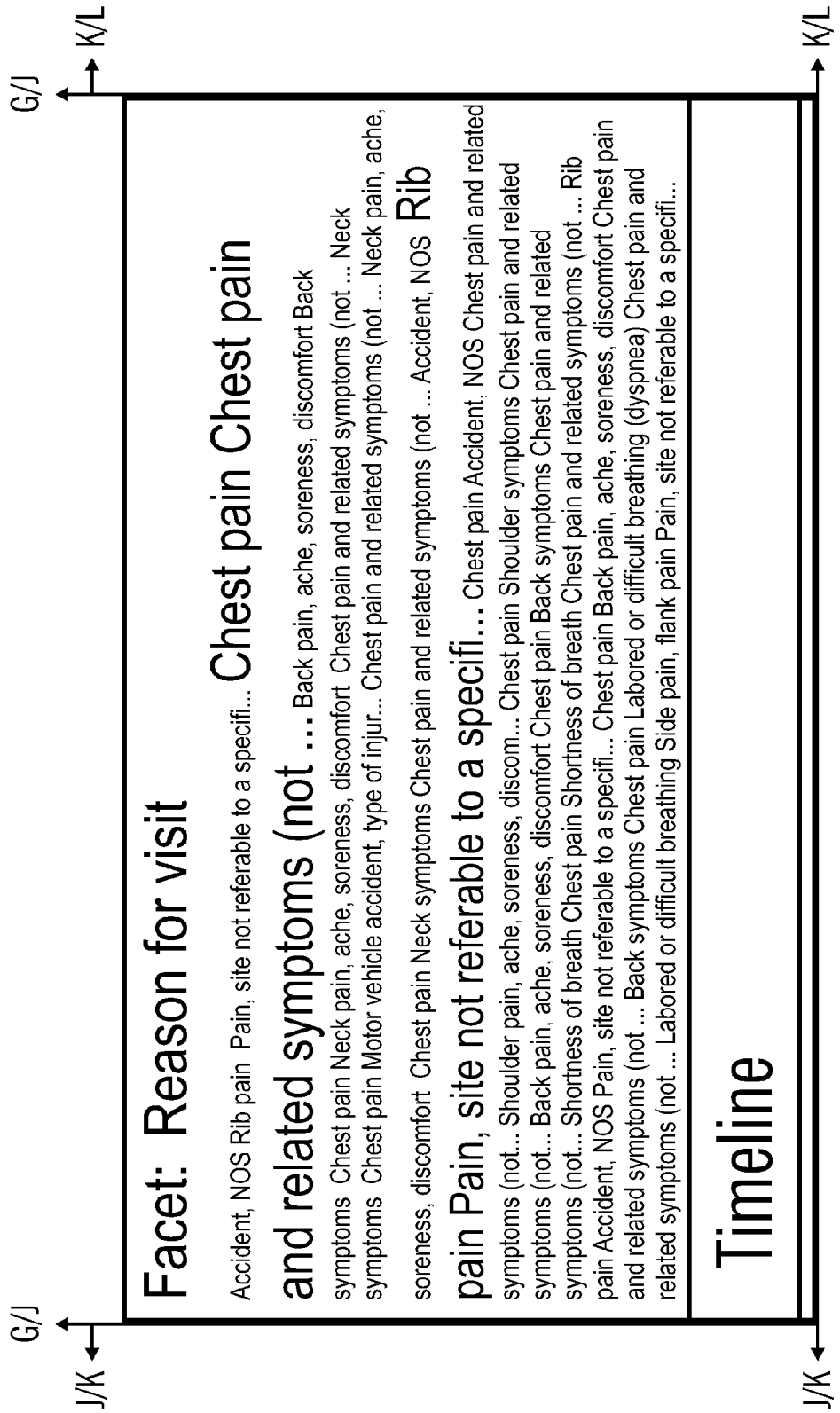
G/J
K/L
J/K
Facet: Reason for visit
Accident, NOS Rib pain Pain, site not referable to a specifi... Chest pain Chest pain and related symptoms (not .... Back pain, ache, soreness, discomfort Back symptoms Chest pain Neck pain, ache, soreness, discomfort Chest pain and related symptoms (not ... Neck symptoms Chest pain Motor vehicle accident, type of injur... Chest pain and related symptoms (not ... Neck pain, ache, soreness, discomfort Chest pain Neck symptoms Chest pain and related symptoms (not ... Accident, NOS Rib pain Pain, site not referable to a specifi... Chest pain Accident, NOS Chest pain and related symptoms (not... Shoulder pain, ache, soreness, discom... Chest pain Shoulder symptoms Chest pain and related symptoms (not... Back pain, ache, soreness, discomfort Chest pain Back symptoms Chest pain and related symptoms (not... Shortness of breath Chest pain Shortness of breath Chest pain and related symptoms (not ... Rib pain Accident, NOS Pain, site not referable to a specifi... Chest pain Back pain, ache, soreness, discomfort Chest pain and related symptoms (not ... Back symptoms Chest pain Labored or difficult breathing (dyspnea) Chest pain and related symptoms (not ... Labored or difficult breathing Side pain, flank pain Pain, site not referable to a specifi...
Timeline
G/J
K/L
J/K

FIG. 10K

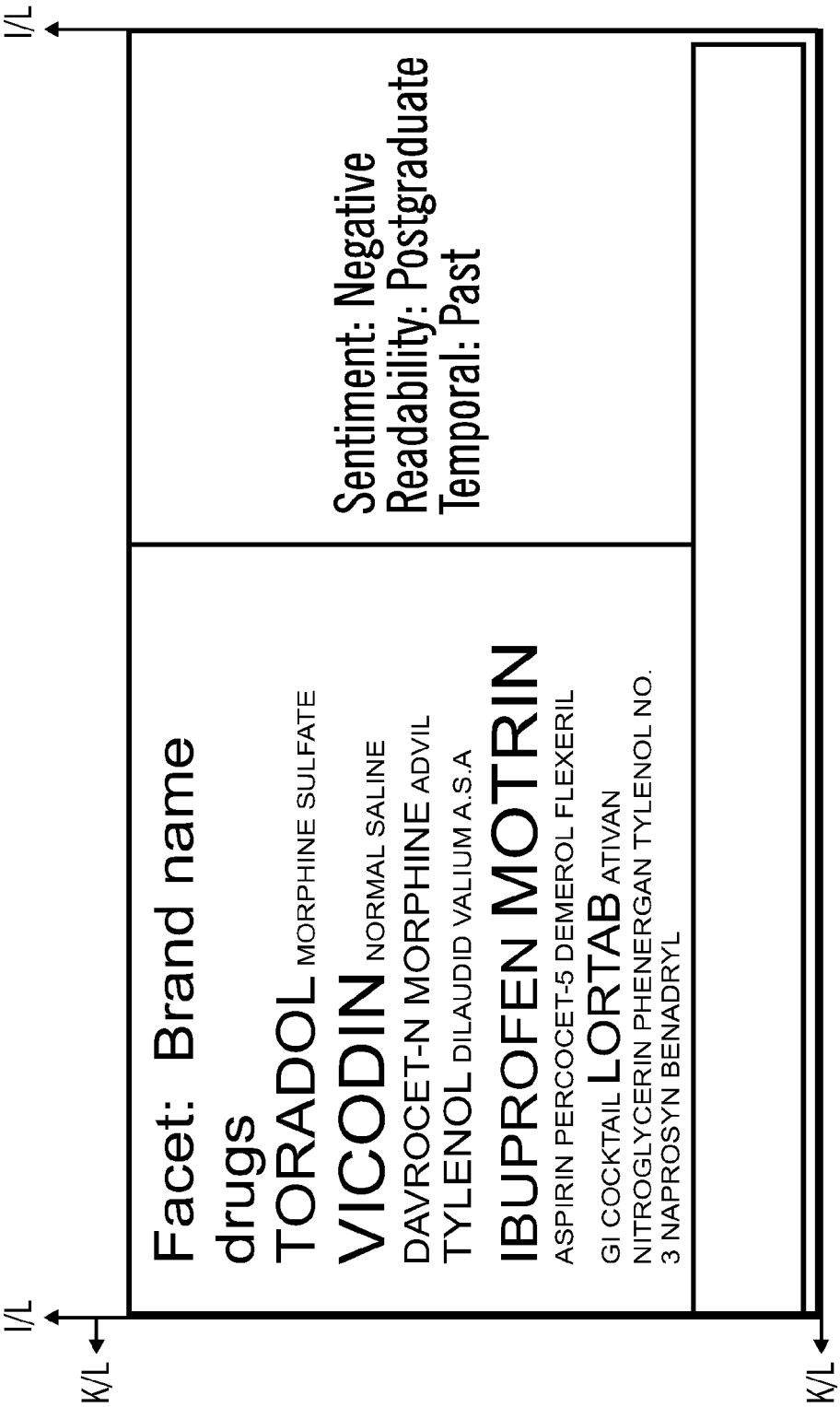
I/L
K/L
I/L
K/L
Facet: Brand name
drugs
TORADOL MORPHINE SULFATE
VICODIN NORMAL SALINE
DAVROCET-N MORPHINE ADVIL
TYLENOL DILAUDID VALIUM A.S.A
IBUPROFEN MOTRIN
ASPIRIN PERCOCET-5 DEMEROL FLEXERIL
GI COCKTAIL LORTAB ATIVAN
NITROGLYCERIN PHENERGAN TYLENOL NO.
3 NAPROSYN BENADRYL
Sentiment: Negative
Readability: Postgraduate
Temporal: Past

FIG. 10L

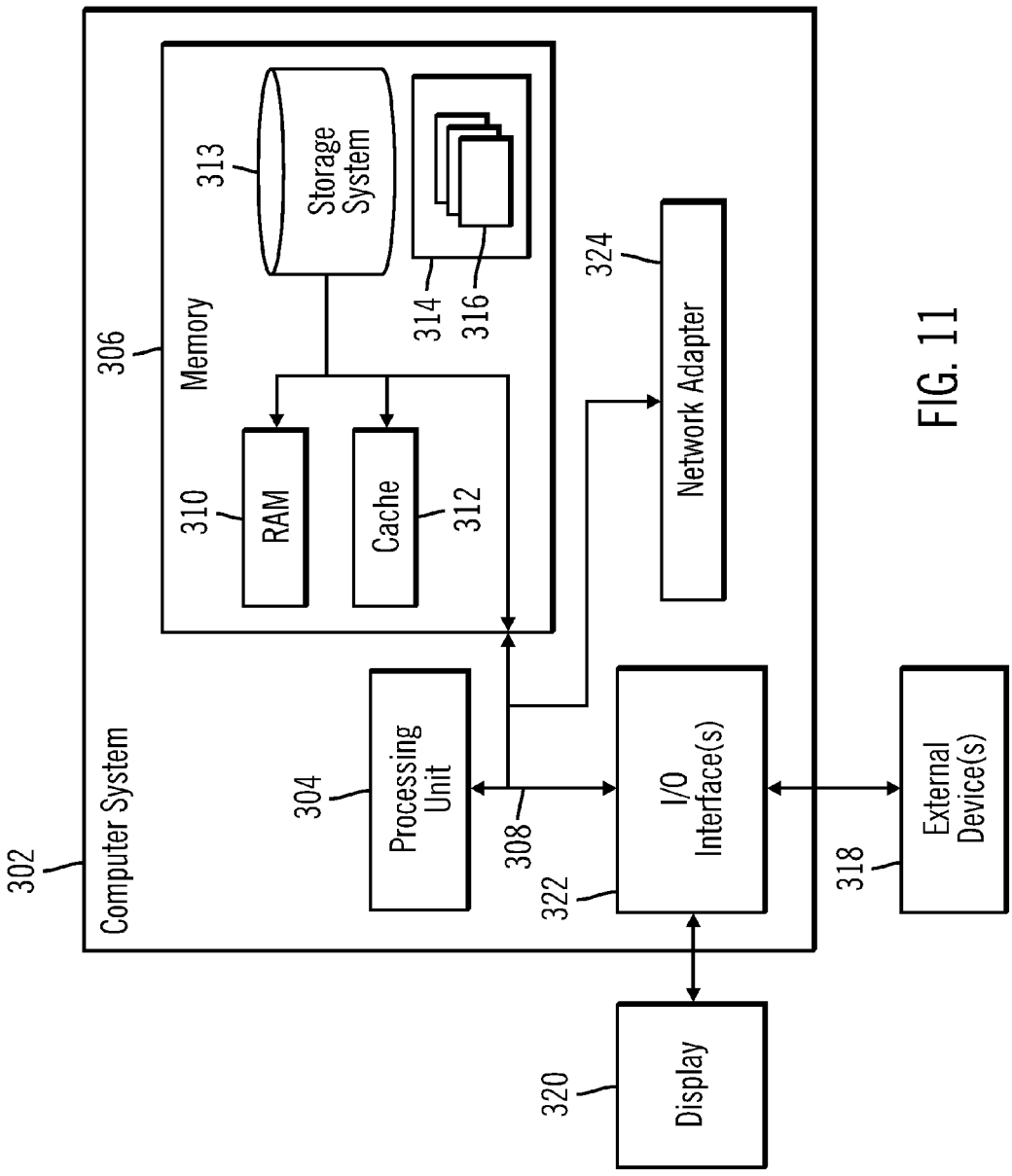
Computer System
302
Memory
306
313
Storage System
314
316
310
RAM
312
Cache
304
Processing Unit
308
322
I/O Interface(s)
324
Network Adapter
318
External Device(s)
320
Display

FIG. 11

GENERATING VISUALIZATIONS OF A DISPLAY GROUP OF TAGS REPRESENTING CONTENT INSTANCES IN OBJECTS SATISFYING A SEARCH CRITERIA

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. patent application Ser. No. 13/463,318, filed May 3, 2012, which is a continuation of U.S. patent application Ser. No. 13/397,596, filed on Feb. 15, 2012, which patent applications are incorporated herein by reference in their entirety.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a computer program product, system, and method for generating visualizations of a display group of tags representing content instances in objects satisfying a search criteria.

2. Description of the Related Art

Search engines allow for searching of unstructured and structured content in objects and documents by indexing terms of the documents in an index associating the terms with the documents that have the terms. The search engine typically produces a list of search results including blocks of text including the text that satisfies the search request criteria. The user must visually scan the list to determine search results that are worth further pursuing by selection of the displayed result to access the document having the result.

There is a need in the art for improved techniques for presenting search results to users to optimize user efficiency when reviewing search results of unstructured and semi-structured content.

SUMMARY

Provided are a computer program product, method, and system for rendering search results. A search request is received having a search criteria to perform with respect to objects having content instances. A determination is made of the objects having qualifying content instances that satisfy the search criteria, an attribute value of the qualifying content instances for a specified attribute, and appearance settings for the qualifying content instances based on the determined attribute values. The appearance settings vary based on the attribute values. Tags are generated indicating the content instances and appearance settings for the content instances. A visualization of the tags in a display group are generated to provide visualization of the qualifying content instances in the objects according to the appearance settings, wherein visualizations of the tags is varied based on the determined appearance settings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates a computing environment in which embodiments are implemented.

FIG. **2** illustrates an embodiment of a display group definition.

FIG. **3** illustrates an embodiment of a display group instance.

FIG. **4** illustrates an embodiment of a tag.

FIG. **5** illustrates an embodiment of operations to process a search request for objects.

FIGS. **6**, **7**, and **8** illustrate embodiments of operations to generate visualizations of display groups of tags.

FIGS. **9** and **9**A through **9**I and FIGS. **10** and **10**A-**10**L illustrate embodiments of generated display groups.

FIG. **11** illustrates an embodiment of a computing architecture.

DETAILED DESCRIPTION

Described embodiments provide techniques to generate display groups to display qualifying content instances from one or more objects that satisfy a search criteria based on an attribute of the qualifying content instances. The attribute used to determine how to display the qualifying content instances may indicate an attribute of the content instances themselves, such as their type, frequency, correlation to the search terms, etc. Additionally, the attribute may specify an annotation, so that the display group provides a visualization of tags representing qualifying content instances for qualifying content instances associated with the specified annotation. Further, tags visualized together in a display group may be from one or more objects.

FIG. **1** illustrates an embodiment of a content analytics system **2** to provide an operating environment to process search requests from clients (not shown) for objects **6** maintained in a repository **4**. The objects **6** may comprise textual documents, multi-media content with textual metadata, a database, and other data. The content analytics system **2** includes a search index **8** providing a listing of the content, such as words and text, in the objects **6**. The index **8** may provide entries for terms and content in the objects **6** and indicate the objects **6** that include that indexed content.

An object processor **10** includes an indexer **12** to crawl the objects **6** to perform the indexing to generate the index **8**. The object processor **10** may further include annotators **14** to apply text analytics to the objects **6** to generate annotations **16** providing additional information on the content of the objects **6**. Text analytics provides techniques to convert textual data into structured data by extracting information from the text, e.g., person names, addresses, etc. and classifying content into categories based on the text. The object processor **10** may further generate facets providing components of information gleaned from the objects **6**, which can be populated with information from structured fields or the text of the objects **6**. The annotator **14** may comply with the Unstructured Information Management Architecture (UIMA), and include such annotators as a language identification annotator to identify the language of each object **6**; a linguistic analysis annotator to apply linguistic analysis to the objects **6**; a dictionary lookup annotator to match words and synonyms from a dictionary with words in the content of the objects **6** and to associate keywords with user-defined facets; a named entity recognition annotator to extract person names, locations, and company names;

A search processor **18** receives search requests from the client (not shown) and may determine objects **6** having content instances that satisfy the query. The search processor **81** may use the index **8** and annotations **16** to determine qualifying content instances, i.e., words or text, in the objects **6** to render as tags in a visualization of a display group, such as a word cloud. The search processor **18** may generate display group information **20** providing information on display groups of tags to generate together that share a common criteria, facets or annotations. A display group identifies tags to be visually presented together as a group, such as in a same display region of a graphical user interface (GUI), word cloud, panel, box, etc. The search processor **18** may construct

a search result page **22** to present display groups including tags representing qualifying content.

The display group information **20** includes display group definitions (FIG. **2**), display group instances (FIG. **3**), and information on tags (FIG. **4**) generated by the object processor **10**, the display group manager **24** or some other component of the content analytics system **2**. A display group manager **24** may be used to update the display group information **20** by allowing the user to define display groups and provide definitions on how to display tags, such as in a word cloud.

The repository **4** may comprise one or more storage devices known in the art, such as interconnected hard disk drives (e.g., configured as a DASD, RAID, JBOD, etc.), solid state storage devices (e.g., EEPROM (Electrically Erasable Programmable Read-Only Memory), flash memory, flash disk, storage-class memory (SCM)), electronic memory, magnetic tape media, tape cartridges, etc. The components of the content analytics system **10**, **18**, and **24** may comprise software programs in a memory executed by a processor. In an alternative embodiment, some portion or all of the programs may be implemented in a hardware component, such as a dedicated integrated circuit, e.g., Application Specific Integrated Circuit (ASIC), expansion card, etc.

FIG. **2** illustrates an embodiment of a display group definition **50**, including a definition name **52**, an object grouping criteria **54** indicating a criteria used to define a group of one or more objects whose content instances will be visualized in the group **50**; a specified attribute **56** that is used to determine which content instances will participate in the group for the objects identified in the object grouping criteria **54**; and appearance rules **58** providing different appearance settings for different attribute **56** values. The object grouping criteria **54** may indicate that the display group is to be generated for only content instances for a single object or from a group of objects, such as one or more objects satisfying a search criteria, predefined number of objects satisfying the search criteria, a number of objects that would be listed on a search results page, etc. The attribute **56** used to vary the appearance of the tags may comprise a frequency of a qualifying content instance satisfying search criteria in the object, a correlation of the qualifying content instances to the search criteria; a degree to which the qualifying content instance makes the object different from content instances in other objects; a correlation of the qualifying content instance to an aggregation of search requests; and an extent to which the qualifying content instance comprises a proper name, address or other identifying information.

Further, the attribute **56** may indicate an annotation type or facet of the data that is used to discriminate among qualifying content instances to present in the display group **50**. For instance, the specified attribute **56** may identify an annotation type so as to only include in the display group **50** qualifying content instances that are associated with the specified annotation type attribute. Examples of annotation types include a tone annotation indicating an author tone, sentiment (e.g., angry, sarcastic, humorous, tragic, etc.) of a context in which the qualifying content instances are used, such that the attribute values **58** used to vary the appearance settings comprise different tones of the context of the qualifying content instances, a frequency of a tone, or correlation of the tone to the search criteria; a noun phrase annotation identifying content instances used in forming noun phrases, where the attribute value **58** indicates a frequency of an occurrence of the qualifying content instances within noun phrases; a named entity annotation indicating qualifying content instances forming person names, organizations and locations, where the attribute values indicate a frequency of an occurrence of the named entity in the object; and a time based annotation indentifying qualifying content instances comprising time based information, wherein the attribute value indicates a chronological time of the qualifying content instance, and wherein the appearance settings indicate a display of the tag on a time line according to an ordering of the chronological times associated with the qualifying content instances. Other types of annotations may also be used to select qualifying content instances to visualize in the display group. Further, the attribute **56** may identify multiple annotations or attributes, to combine in the display group **50**.

A user of the content analytics system **2** may utilize a GUI provided by the display group manager **22** to create one or more display group definitions **50** for different object grouping criteria **54** and attributes **56** to be applied to display search results in response to search requests from clients (not shown) with respect to the objects **6**.

FIG. **3** illustrates an embodiment of a display group instance **70** comprising a particular instance of a display group formed according to one display group definition **50**. A display group instance **70** includes an identifier **72** of the instance, a definition name **74** identifying a display group definition **50** from which the instance **70** was created, and one or more tags **76** representing qualifying content instances in object as selected according to the display group definition **74** for which the instance was created. The display group instances **70** maybe generated when processing search results returned for a search query.

FIG. **4** illustrates an embodiment of a tag **80**, including a content instance **82**, such as a text item; an object **84** including the content instance **82**; an appearance attribute value **86** used to determine how the tag is to be displayed, and an appearance setting **88** indicating how the content instance **82** is to visually appear in the display group (e.g., word cloud), such as font size, color, font, boldness, etc. The appearance rules **58** may be used to determine the appearance setting **88** corresponding to the appearance attribute value **86** determined for the content instance. The appearance attribute value **86** may provide a value for the display attribute **56** for the display group for which the tag is being generated, such as a frequency of the content instance **82** in the object, a correlation of the content instance **82** to the search criteria, an annotation of the annotation type corresponding to the display attribute **56**, etc.

FIGS. **5-8** illustrate embodiments of operations performed by components of the content analytics system **2**, such as the object processor **10** and search processor **18** to process a search request to generate visualizations of display groups of tags. With respect to FIG. **5**, upon the search processor **18** receiving (at block **100**) a search request providing search criteria with respect to the objects **6** from a client (not shown), the search processor **18** determines (at block **102**) from the index **8** the objects **6** having qualifying content instances that satisfy the search criteria. Qualifying content instances that satisfy the search criteria may comprise content that matches the search criteria, such as a word stem of the content matching a word stem of the search terms, and/or comprise content that is correlated to the search criteria, such as determined by using data mining and/or text mining techniques.

The search processor **18** determines (at block **104**) an attribute value **86** of the qualifying content instances for the specified attribute **56**, and may store this information in tags **80** created for the qualifying content instances. The search processor **18** determines (at block **106**) appearance settings **88** for the qualifying content instances based on the determined attribute values **86**, such that the appearance settings **88** may vary based on the determined attribute values **86**. The search processor **18** may store this determined information in

the tags **80** created for the qualifying content instances. The search processor **18** may generate (at block **110**) with the rendering of the visualization of the tags in the display group links to information on the objects having the qualifying content instances visualized by the tags. The links may be to the object itself, or to a page of search results including the object having the qualifying content instance of the tag. The search processor **18** renders a visualization (at block **112**) of tags grouped together (such as in one word cloud) based on an object grouping criteria, such as one object in the display group, a number of objects, such as a number of objects based on the number of results returned per page.

FIG. **6** illustrates an embodiment of operations performed by the search processor **16** or other component of the content analytics system **2** to generate a visualization of an aggregate display group of tags when the object grouping criteria is a group number of objects to group in one display region (e.g., a word cloud, panel, displayed shape, etc.). An aggregate display group aggregates tags from multiple objects to visualize in a single group. Upon initiating (at block **130**) the operation to generate the display group, the search processor **18** determines (at block **132**) the group number, such as a maximum number of search results per page. The search processor **18** forms (at block **134**) at least one display group instance **70** for the objects having qualifying content instances, wherein each display group instance **70** includes tags **76** for qualifying content instances in groups for up to the determined group number of objects. For each display group instance, the search processor **18** generates (at block **136**) a visualization of an aggregate display group (e.g., word cloud) including visualizations of the tags **76** in the objects in the display group instance. At least one of the generated aggregate display groups (clouds) may be included (at block **138**) on a search result page **22** to return to the client that originated the search.

In certain embodiments, selection of the visualized aggregate display group instance may provide a link to a search result page providing information on the objects having content instances represented by tags in the visualized display group. In further embodiments, the visualized aggregate display group may not be on the search results page. Instead, there may be a page of visualized aggregate display groups which provide indexes to the search results represented by the visualized aggregate display groups. Alternatively, there may be visualized aggregate display groups on the search results page for the search results in previous and next pages, linked to those pages, to serve as a visual means of determining if the user wants to go to the next (or previous) page. There may be further visualized aggregates of the aggregates to provide further visual abstractions.

FIG. **7** illustrates an embodiment of operations performed by the search processor **18** or other component of the content analytics system **2** to generate display group instances **70** for multiple display group definitions **50** for an object having qualifying content instances satisfying the search criteria. Upon initiating (at block **150**) the operation to generate display group instances, the search processor **18** generates (at block **152**) a first display group instance **70** from a first display group definition **50**, specifying a correlation display attribute **56**, including tags based on a correlation attribute value of the qualifying content instances to the search criteria. The tags **76** may have appearance settings **88** based on their correlation value to the search criteria, e.g., content instances having stronger correlation to the search criteria are displayed with a more prominent or different appearance than those content instances having weaker correlation. The search processor **18** applies (at block **154**) the appearance settings **88** of the tags **78** in the first display group instance to display the tags in the visualized first display group. The search processor **18** generates (at block **156**) a second display group instance **70** from a second display group definition **50** including tags **76** based on a frequency attribute value of the qualifying content instances in the object. The tags for the second display group may have appearance settings based on their frequency value. The appearance settings **88** are applied (at block **158**) to the tags **76** in the second display group instance **70** to display the tags in the visualized second display group. The search processor **18** may further generate (at block **160**) a third display instance **70** including tags **76** of qualifying content instances **82** based on a difference attribute value indicating an extent to which the qualifying content instance **82** makes the object in which the content is included different from other objects, according to a scope, where scope can be varied between the page, all pages or entire set or collection of objects. The appearance settings **88** are applied (at block **162**) to the tags **76** in the third display group instance to display the tags in the visualized third display group instance.

FIG. **8** illustrates an embodiment of operations performed by the object processor **10** and the search processor **18** to generate display groups based on annotations associated with qualifying content instances in the objects **6**. Upon initiating the operation to visualize display groups based on annotations, the annotators **14** may perform (at block **182**) analytics on the determined objects to determine annotations for the qualifying content instances of the objects. The determination of annotations may be performed with respect to objects having qualifying content instances after determining the qualifying content instances or before receiving the search request, such as during an indexing operation performed with respect to all content in the all the objects **6** in the repository **4**. The search processor **18** determines (at block **184**) the objects having annotations for each annotation type for which a display group will be generated. For each annotation type for which a display group instance **70** will be generated, the search processor **18** generates (at block **186**) tags for the qualifying content instances associated with annotations corresponding to the annotation type to visualize in the display group for that annotation type. The appearance settings of the tags are applied (at block **188**) to the tags rendered in the display group for the annotation type to vary the appearance of the tags based on the annotation of the annotation type associated with the qualifying content instance.

FIGS. **9** and **9**A through **9**I illustrate an example of displaying multiple word clouds in a row for one medical report, comprising the object. FIGS. **9**A through **9**I provide views of the cloud panels shown in FIG. **9**. Multiple rows are displayed to provide word clouds for different reports having content or text satisfying search results. A first word cloud **200** in a row **202** displays dynamic summary of a report (object) based on the query, with search terms highlighted. A second word cloud **204** in the row adjusts appearance based on frequency of the terms satisfying the search results and a third word cloud **206** displays terms based on text analytics for words having a pharmaceutical annotation, indicating words that are pharmaceuticals, with the appearance varying based on the frequency of the pharmaceutical word. A fourth word cloud **208** comprises a timeline of dates mentioned in the report is also displayed for that report. The other two rows display similar word clouds for different medical reports/objects.

Further, word clouds can be generated that aggregate results for multiple objects, so selection of that word cloud displays the word clouds for each of the objects aggregated in the aggregate word cloud. FIGS. **10** and **10**A through **10**L show aggregate word cloud **230** that aggregates results for

multiple of the word clouds for different medical reports **232**. FIGS. **10**A through **10**L provide views of the cloud panels shown in FIG. **10**. Selection of aggregate cloud **230** displays a page of results **232** aggregated by the aggregate cloud **230**. For instance aggregate cloud **234** aggregates the results for the reasons for visit cloud, such as cloud **236**.

Described embodiments provide techniques for generating display groups to provide visualizations of qualifying content instances satisfying a search criteria based on attributes of the qualifying content instances that are used to determine what qualifying content instances appear in the visualization of the display group and the appearance of tags representing the qualifying content instances.

The described operations may be implemented as a method, apparatus or computer program product using standard programming and/or engineering techniques to produce software, firmware, hardware, or any combination thereof. Accordingly, aspects of the embodiments may take the form of an entirely hardware embodiment, an entirely software embodiment (including firmware, resident software, microcode, etc.) or an embodiment combining software and hardware aspects that may all generally be referred to herein as a "circuit," "module" or "system." Furthermore, aspects of the embodiments may take the form of a computer program product embodied in one or more computer readable medium(s) having computer readable program code embodied thereon.

Any combination of one or more computer readable medium(s) may be utilized. The computer readable medium may be a computer readable signal medium or a computer readable storage medium. A computer readable storage medium may be, for example, but not limited to, an electronic, magnetic, optical, electromagnetic, infrared, or semiconductor system, apparatus, or device, or any suitable combination of the foregoing. More specific examples (a non-exhaustive list) of the computer readable storage medium would include the following: an electrical connection having one or more wires, a portable computer diskette, a hard disk, a random access memory (RAM), a read-only memory (ROM), an erasable programmable read-only memory (EPROM or Flash memory), an optical fiber, a portable compact disc read-only memory (CD-ROM), an optical storage device, a magnetic storage device, or any suitable combination of the foregoing. In the context of this document, a computer readable storage medium may be any tangible medium that can contain or store a program for use by or in connection with an instruction execution system, apparatus, or device.

A computer readable signal medium may include a propagated data signal with computer readable program code embodied therein, for example, in baseband or as part of a carrier wave. Such a propagated signal may take any of a variety of forms, including, but not limited to, electro-magnetic, optical, or any suitable combination thereof. A computer readable signal medium may be any computer readable medium that is not a computer readable storage medium and that can communicate, propagate, or transport a program for use by or in connection with an instruction execution system, apparatus, or device.

Program code embodied on a computer readable medium may be transmitted using any appropriate medium, including but not limited to wireless, wireline, optical fiber cable, RF, etc., or any suitable combination of the foregoing.

Computer program code for carrying out operations for aspects of the present invention may be written in any combination of one or more programming languages, including an object oriented programming language such as Java, Smalltalk, C++ or the like and conventional procedural programming languages, such as the "C" programming language or similar programming languages. The program code may execute entirely on the user's computer, partly on the user's computer, as a stand-alone software package, partly on the user's computer and partly on a remote computer or entirely on the remote computer or server. In the latter scenario, the remote computer may be connected to the user's computer through any type of network, including a local area network (LAN) or a wide area network (WAN), or the connection may be made to an external computer (for example, through the Internet using an Internet Service Provider).

Aspects of the present invention are described above with reference to flowchart illustrations and/or block diagrams of methods, apparatus (systems) and computer program products according to embodiments of the invention. It will be understood that each block of the flowchart illustrations and/or block diagrams, and combinations of blocks in the flowchart illustrations and/or block diagrams, can be implemented by computer program instructions. These computer program instructions may be provided to a processor of a general purpose computer, special purpose computer, or other programmable data processing apparatus to produce a machine, such that the instructions, which execute via the processor of the computer or other programmable data processing apparatus, create means for implementing the functions/acts specified in the flowchart and/or block diagram block or blocks.

These computer program instructions may also be stored in a computer readable medium that can direct a computer, other programmable data processing apparatus, or other devices to function in a particular manner, such that the instructions stored in the computer readable medium produce an article of manufacture including instructions which implement the function/act specified in the flowchart and/or block diagram block or blocks.

The computer program instructions may also be loaded onto a computer, other programmable data processing apparatus, or other devices to cause a series of operational steps to be performed on the computer, other programmable apparatus or other devices to produce a computer implemented process such that the instructions which execute on the computer or other programmable apparatus provide processes for implementing the functions/acts specified in the flowchart and/or block diagram block or blocks.

The terms "an embodiment", "embodiment", "embodiments", "the embodiment", "the embodiments", "one or more embodiments", "some embodiments", and "one embodiment" mean "one or more (but not all) embodiments of the present invention(s)" unless expressly specified otherwise.

The terms "including", "comprising", "having" and variations thereof mean "including but not limited to", unless expressly specified otherwise.

The enumerated listing of items does not imply that any or all of the items are mutually exclusive, unless expressly specified otherwise.

The terms "a", "an" and "the" mean "one or more", unless expressly specified otherwise.

Devices that are in communication with each other need not be in continuous communication with each other, unless expressly specified otherwise. In addition, devices that are in communication with each other may communicate directly or indirectly through one or more intermediaries.

A description of an embodiment with several components in communication with each other does not imply that all such components are required. On the contrary a variety of optional components are described to illustrate the wide variety of possible embodiments of the present invention.

Further, although process steps, method steps, algorithms or the like may be described in a sequential order, such processes, methods and algorithms may be configured to work in alternate orders. In other words, any sequence or order of steps that may be described does not necessarily indicate a requirement that the steps be performed in that order. The steps of processes described herein may be performed in any order practical. Further, some steps may be performed simultaneously.

When a single device or article is described herein, it will be readily apparent that more than one device/article (whether or not they cooperate) may be used in place of a single device/article. Similarly, where more than one device or article is described herein (whether or not they cooperate), it will be readily apparent that a single device/article may be used in place of the more than one device or article or a different number of devices/articles may be used instead of the shown number of devices or programs. The functionality and/or the features of a device may be alternatively embodied by one or more other devices which are not explicitly described as having such functionality/features. Thus, other embodiments of the present invention need not include the device itself.

The illustrated operations of the figures show certain events occurring in a certain order. In alternative embodiments, certain operations may be performed in a different order, modified or removed. Moreover, steps may be added to the above described logic and still conform to the described embodiments. Further, operations described herein may occur sequentially or certain operations may be processed in parallel. Yet further, operations may be performed by a single processing unit or by distributed processing units.

The elements of the computing environment of FIG. **1**, including the object processor **10**, search processor **18**, and display group manager **24** may be implemented in one or more computer systems, such as the computer system **302** shown in FIG. **11**. Computer system/server **302** may be described in the general context of computer system executable instructions, such as program modules, being executed by a computer system. Generally, program modules may include routines, programs, objects, components, logic, data structures, and so on that perform particular tasks or implement particular abstract data types. Computer system/server **302** may be practiced in distributed cloud computing environments where tasks are performed by remote processing devices that are linked through a communications network. In a distributed cloud computing environment, program modules may be located in both local and remote computer system storage media including memory storage devices.

As shown in FIG. **11**, the computer system/server **302** is shown in the form of a general-purpose computing device. The components of computer system/server **302** may include, but are not limited to, one or more processors or processing units **304**, a system memory **306**, and a bus **308** that couples various system components including system memory **306** to processor **304**. Bus **308** represents one or more of any of several types of bus structures, including a memory bus or memory controller, a peripheral bus, an accelerated graphics port, and a processor or local bus using any of a variety of bus architectures. By way of example, and not limitation, such architectures include Industry Standard Architecture (ISA) bus, Micro Channel Architecture (MCA) bus, Enhanced ISA (EISA) bus, Video Electronics Standards Association (VESA) local bus, and Peripheral Component Interconnects (PCI) bus.

Computer system/server **302** typically includes a variety of computer system readable media. Such media may be any available media that is accessible by computer system/server **302**, and it includes both volatile and non-volatile media, removable and non-removable media.

System memory **306** can include computer system readable media in the form of volatile memory, such as random access memory (RAM) **310** and/or cache memory **312**. Computer system/server **302** may further include other removable/non-removable, volatile/non-volatile computer system storage media. By way of example only, storage system **313** can be provided for reading from and writing to a non-removable, non-volatile magnetic media (not shown and typically called a "hard drive"). Although not shown, a magnetic disk drive for reading from and writing to a removable, non-volatile magnetic disk (e.g., a "floppy disk"), and an optical disk drive for reading from or writing to a removable, non-volatile optical disk such as a CD-ROM, DVD-ROM or other optical media can be provided. In such instances, each can be connected to bus **308** by one or more data media interfaces. As will be further depicted and described below, memory **306** may include at least one program product having a set (e.g., at least one) of program modules that are configured to carry out the functions of embodiments of the invention.

Program/utility **314**, having a set (at least one) of program modules **316**, may be stored in memory **306** by way of example, and not limitation, as well as an operating system, one or more application programs, other program modules, and program data. Each of the operating system, one or more application programs, other program modules, and program data or some combination thereof, may include an implementation of a networking environment. The components of the computer **2** may be implemented as program modules **316** which generally carry out the functions and/or methodologies of embodiments of the invention as described herein. The components **10**, **18**, and **24** of the content analytics system **2** may be implemented in one or more computer systems **302**, where if they are implemented in multiple computer systems **302**, then the computer systems may communicate over a network.

Computer system/server **302** may also communicate with one or more external devices **318** such as a keyboard, a pointing device, a display **320**, etc.; one or more devices that enable a user to interact with computer system/server **12**; and/or any devices (e.g., network card, modem, etc.) that enable computer system/server **302** to communicate with one or more other computing devices. Such communication can occur via Input/Output (I/O) interfaces **322**. Still yet, computer system/server **302** can communicate with one or more networks such as a local area network (LAN), a general wide area network (WAN), and/or a public network (e.g., the Internet) via network adapter **324**. As depicted, network adapter **324** communicates with the other components of computer system/server **302** via bus **308**. It should be understood that although not shown, other hardware and/or software components could be used in conjunction with computer system/server **302**. Examples, include, but are not limited to: microcode, device drivers, redundant processing units, external disk drive arrays, RAID systems, tape drives, and data archival storage systems, etc.

The foregoing description of various embodiments of the invention has been presented for the purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form disclosed. Many modifications and variations are possible in light of the above teaching. It is intended that the scope of the invention be limited not by this detailed description, but rather by the claims appended hereto. The above specification, examples and data provide a complete description of the manufacture and use of the com-

position of the invention. Since many embodiments of the invention can be made without departing from the spirit and scope of the invention, the invention resides in the claims herein after appended.

What is claimed is:

1. A computer program product for rendering search results, the computer program product comprising a non-transitory computer readable storage medium having computer readable program code embodied therein that executes to perform operations, the operations comprising:

receiving a search request having a search criteria to perform with respect to objects having content instances;

determining the objects having qualifying content instances that satisfy the search criteria;

determining attribute values of the qualifying content instances for a specified attribute;

determining appearance settings for the qualifying content instances based on the attribute values, wherein the appearance settings vary based on the attribute values;

generating tags indicating the content instances and appearance settings for the qualifying content instances, wherein there is a tag for each of the qualifying content instances indicating an attribute value and an appearance setting for a qualifying content instance; and

generating visualizations of the tags in a display group to provide visualizations of the qualifying content instances in the objects according to the appearance settings, wherein the visualizations of the tags is varied based on the appearance settings.

2. The computer program product of claim **1**, wherein each of the visualizations of the tags includes a link to information on the object having a qualifying content instance visualized by the tag.

3. The computer program product of claim **1**, wherein the tags are visualized in a word cloud.

4. The computer program product of claim **3**, wherein the operations further comprise:

generating, for each of a plurality of the objects, visualizations of a plurality of word clouds, wherein the word clouds generated for one object provide appearance settings for the tags based on different attributes.

5. The computer program product of claim **1**, wherein the specified attribute used to vary the appearance of the tags is a member of a group of attributes consisting of: a frequency of the qualifying content instance in the object; a correlation of the qualifying content instance to the search criteria; a degree to which the qualifying content instance makes the object different from content instances in other objects; a correlation of the qualifying content instance to an aggregation of search requests; and an extent to which the qualifying content instance comprises a proper name.

6. The computer program product of claim **1**, wherein generating the visualization comprises displaying for each object:

a first cloud displaying tags based on a correlation of the qualifying content instances to the search criteria, wherein the appearance settings of the tags vary based on a strength of the correlation of the qualifying content instances to the search criteria;

a second cloud displaying tags based on a frequency of occurrences of the qualifying content instances in the object, wherein the appearance settings of the tags vary based on the frequency of the occurrences of qualifying content instances in the object; and

a third cloud including tags of qualifying content instances that make the object different from the qualifying content instances in other of the objects, wherein the appearance settings of the qualifying content instances vary based on a strength of an extent to which the qualifying content instances makes the object different from the other objects having qualifying content instances.

7. The computer program product of claim **1**, wherein the operations further comprise:

performing analytics on the determined objects to determine annotations for the qualifying content instances of the objects; and

determining the objects having annotations of an annotation type, wherein the specified attribute comprises the annotation type, and wherein the generated tags are for the qualifying content instances having annotation values corresponding to the annotation type, wherein the appearance settings of the tags vary based on the annotation of the annotation type associated with the qualifying content instances.

8. The computer program product of claim **7**, wherein the operations further comprise:

displaying a plurality of word clouds for different annotation types, wherein each of the word clouds is associated with one of the annotation types and displays tags for the qualifying content instances, in at least one of the objects, associated with the annotation of the annotation type of the word cloud.

9. A system, comprising:

a processor; and

a computer readable storage medium having computer readable program code executed by the processor to perform operations, the operations comprising:

receiving a search request having a search criteria to perform with respect to objects having content instances;

determining the objects having qualifying content instances that satisfy the search criteria;

determining attribute values of the qualifying content instances for a specified attribute;

determining appearance settings for the qualifying content instances based on the attribute values, wherein the appearance settings vary based on the attribute values;

generating tags indicating the qualifying content instances and appearance settings for the content instances, wherein there is a tag for each of the qualifying content instances indicating an attribute value and an appearance setting for a qualifying content instance; and

generating a visualization of the tags in a display group to provide visualization of the qualifying content instances in the objects according to the appearance settings, wherein visualizations of the tags is varied based on the appearance settings.

10. The system of claim **9**, wherein each of the visualizations of the tags includes a link to information on the object having a qualifying content instance visualized by the tag.

11. The computer program product of claim **1**, wherein the tags are visualized in a word cloud.

12. The system of claim **9**, wherein the operations further comprise:

generating, for each of a plurality of the objects, visualizations of a plurality of word clouds, wherein the word clouds generated for one object provide appearance settings for the tags based on different attributes.

13. The system of claim **9**, wherein the operations further comprise:

performing analytics on the determined objects to determine annotations for the qualifying content instances of the objects; and

determining the objects having annotations of an annotation type, wherein the specified attribute comprises the annotation type, and wherein the generated tags are for the qualifying content instances having annotation values corresponding to the annotation type, wherein the appearance settings of the tags vary based on the annotation of the annotation type associated with the qualifying content instances.

14. The system of claim **13**, wherein the operations further comprise:

displaying a plurality of word clouds for different annotation types, wherein each of the word clouds is associated with one of the annotation types and displays tags for the qualifying content instances, in at least one of the objects, associated with the annotation of the annotation type of the word cloud.

15. A method for rendering search results in a computer system, comprising:

receiving a search request having a search criteria to perform with respect to objects in a computer readable storage medium having content instances;

determining the objects having qualifying content instances that satisfy the search criteria;

determining attribute values of the qualifying content instances for a specified attribute;

determining appearance settings for the qualifying content instances based on the attribute values, wherein the appearance settings vary based on the attribute values;

generating tags indicating the qualifying content instances and appearance settings for the qualifying content instances, wherein there is a tag for each of the qualifying content instances indicating an attribute value and an appearance setting for an qualifying content instance; and

generating a visualization of the tags in a display group to provide visualization of the qualifying content instances in the objects according to the appearance settings, wherein visualizations of the tags is varied based on the appearance settings.

16. The method of claim **15**, wherein each of the visualizations of the tags includes a link to information on the object having a qualifying content instance visualized by the tag.

17. The method of claim **15**, wherein the tags are visualized in a word cloud.

18. The method of claim **17**, further comprise:

generating for each of a plurality of objects visualizations of a plurality of word clouds, wherein the word clouds generated for one object provide appearance settings for the tags based on different attributes.

19. The method of claim **15**, wherein generating the visualization comprises displaying for each object:

a first cloud displaying tags based on a correlation of the qualifying content instances to the search criteria, wherein the appearance settings of the tags vary based on a strength of the correlation of the qualifying content instances to the search criteria;

a second cloud displaying tags based on a frequency of an occurrence of the qualifying content instances in the object, wherein the appearance settings of the tags vary based on the frequency of the occurrences of qualifying content instances in the object; and

a third cloud including tags of qualifying content instances that make the object different from the qualifying content instances in other of the objects, wherein the appearance settings of the qualifying content instances vary based on a strength of an extent to which the qualifying content instances makes the object different from the other objects having qualifying content instances.

20. The method of claim **15**, further comprising:

performing analytics on the determined objects to determine annotations for the qualifying content instances of the objects; and

determining the objects having annotations of an annotation type, wherein the specified attribute comprises the annotation type, and wherein the generated tags are for the qualifying content instances having annotation values corresponding to the annotation type, wherein the appearance settings of the tags vary based on the annotation of the annotation type associated with the qualifying content instances.

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